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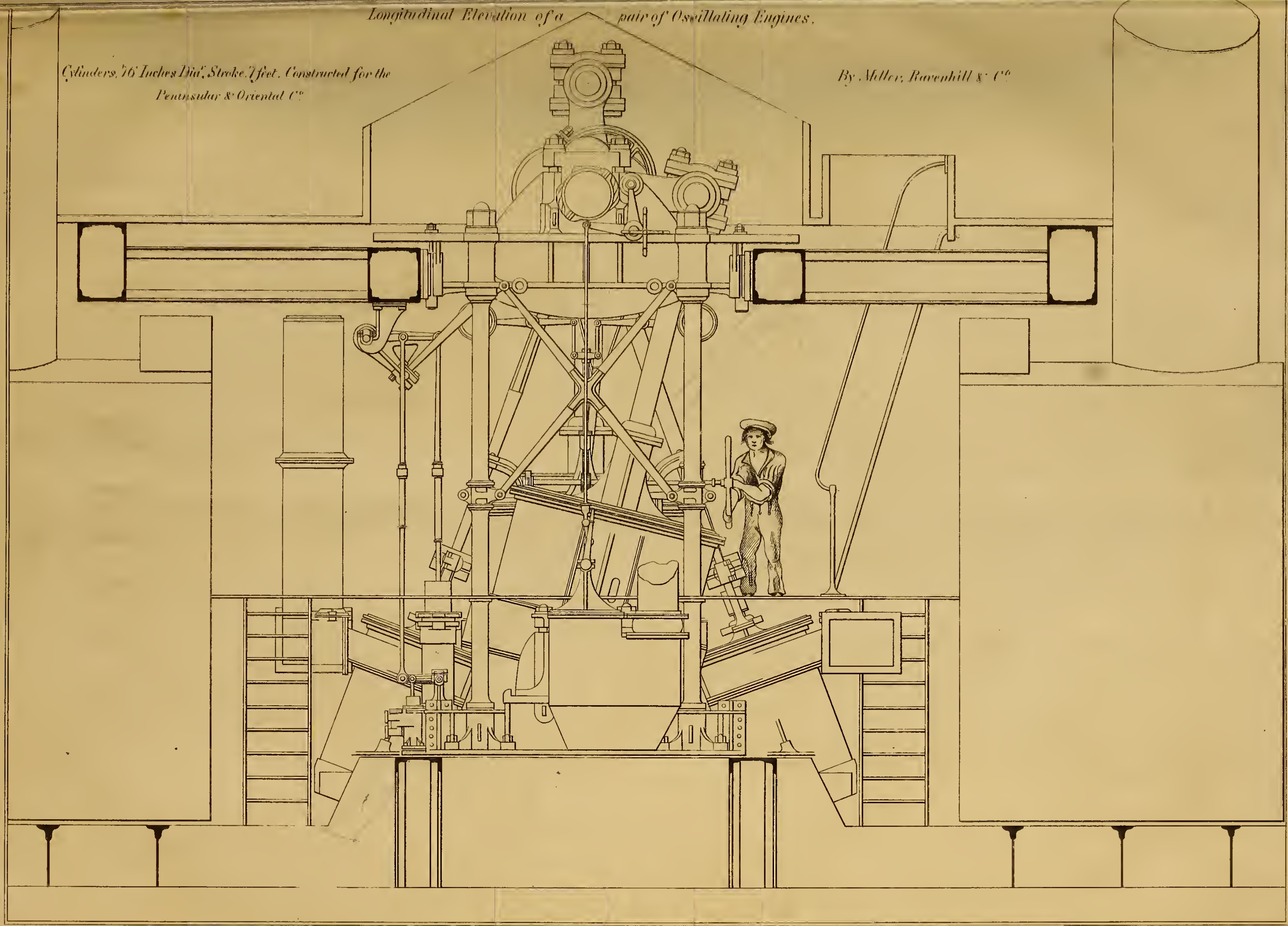


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# THE ARTIZAN.

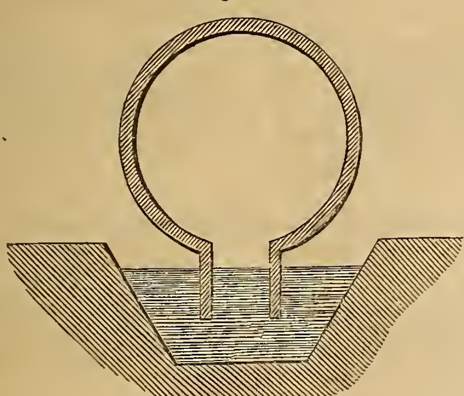
No. XIII. New Series.—JANUARY 3rd, 1846.

## Art. I.—VARIETIES OF THE ATMOSPHERIC RAILWAY.

The atmospheric railway is assuming an important position in the public eye, and we are by no means certain that at a period not far distant it may not supersede the more orthodox methods of railway locomotion. We have on several occasions explained the nature of the arrangements adopted in the atmospheric railways on Clegg and Samuda's plan, and have also investigated the physical principles on which the contrivance is founded. A large crop of other devices for atmospheric propulsion have however sprung up, which seem to demand some notice, and we here propose to offer a few remarks illustrative of the nature and merits of these new candidates for admiration.

The communication of motion to objects at a distance by the use of a pipe into which air was compressed, or from which it was exhausted, is a very ancient conception. In 1810, a projector named Medhurst suggested a scheme of the kind for the conveyance of carriages; he was followed by Lewis in 1817, and by Vallance in 1824. Vallance proposed to place his carriages in a tnnnel, out of the front part of which the air was partially exhausted, and he made some experiments near Brighton to test the efficacy on the plan, He proposed to place stationary engines at intervals along the life to maintain the requisite exhaustion. These schemes all came to nothing. In 1827, Medhurst published a pamphlet, in which he proposed several methods of propelling carriages situated on the outside of the pipe.

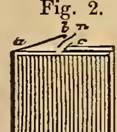
Fig. 1.



MEDHURST.

Fig. 1. represents one of these contrivances, consisting of a tube with a neck emerged in a canal of water. Within the tube a piston moves, and from the piston, a bent iron passes through the neck, which communicates with the carriages outside and put them into motion, when the tube, in advance of the piston, is partially exhausted. This scheme is obviously an impossible one. The neck would require to be of an immense depth to counteract the disposition of the vacuum to draw the water into the tube; the plan would not be applicable on the slightest incline, and the water in winter would freeze.

Fig. 2.

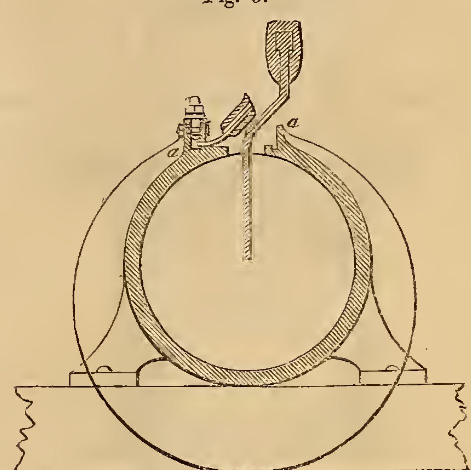


MEDHURST.

Another scheme is that represented in Fig. 2, which is a section of an iron tube with a wrought iron semi top, *a b* rivetted to the flange, and which is lifted up by means of a wheel attached to a piston moving within the tube. The crooked iron arm *n*, projects through the opening made by raising the semi top, and to this iron arm the train is attached. The piston is considerably in advance of the opening, whereby leakage through it is prevented. There is a slight projection at *e*, upon which the moveable lid shuts down tight, and which prevents air or dust from entering the tube. This plan was never brought into practical operation.

In 1834, Mr. Pinkus took out a patent for an atmospheric railway, which he employed a round tube, and the valve consisted of a rope or cor

Fig. 3.

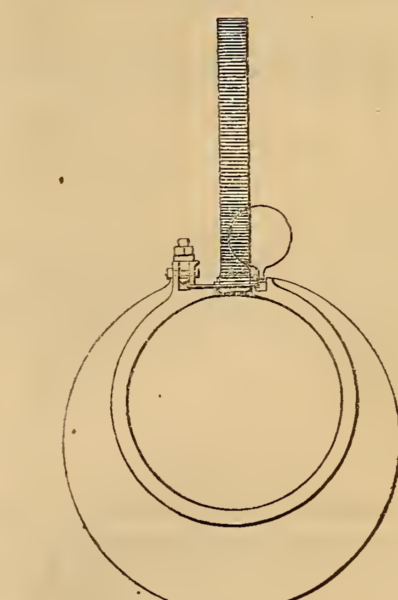


CLEGG & SAMUDA.

*Mode of Opening the Valve.*

of a particular composition, fitting into a recess on the top of the pipe. The cross section of this cord was slightly conical, so as to act like a cork

Fig. 4.



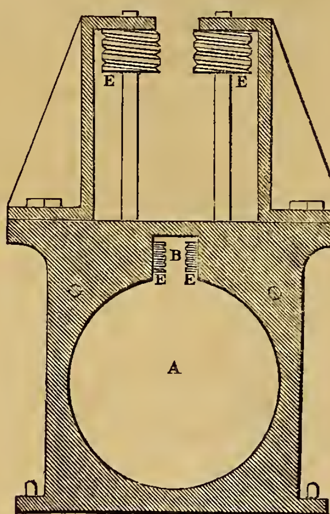
CLEGG & SAMUDA.

*Mode of Closing the Valve.*

The cord was lifted out of its place by wheels, when the carriage was in the act of passing, and was pressed down after the connecting arm had passed hy other wheels suitably arranged for that purpose. In 1836, Mr. Pinkus took out another patent, in which, instead of the valvular cord, he made use of a valve composed of two inclined plates of steel A, between which a knife edge arm passed which was hollow, and established a connection between the interior of the pipe, and a locomotive engine on the rails worked by the atmospheric pressure. Mr. Pinkus appears to have been very early in the field, and to him, it appears to us, is due, if not the first practical application, the first practical development of the atmospheric system.

In 1839, Messrs. Clegg and Samuda made an improvement in the valves of atmospheric railways. They employed a flap valve resembling that proposed hy Medhurst, and nearly identical with a form of valve already projected hy Pinkus; hut they made the valve tight hy the application of a composition of wax and tallow, which was spread over the joining edge by a hot iron carried by the train. Fig. 3, is a cross section of the pipe in Clegg and Samuda's arrangement, shown with the valve open, and the curved iron projecting through the slit. Fig. 4, is a cross section of the pipe, with the

Fig. 5.

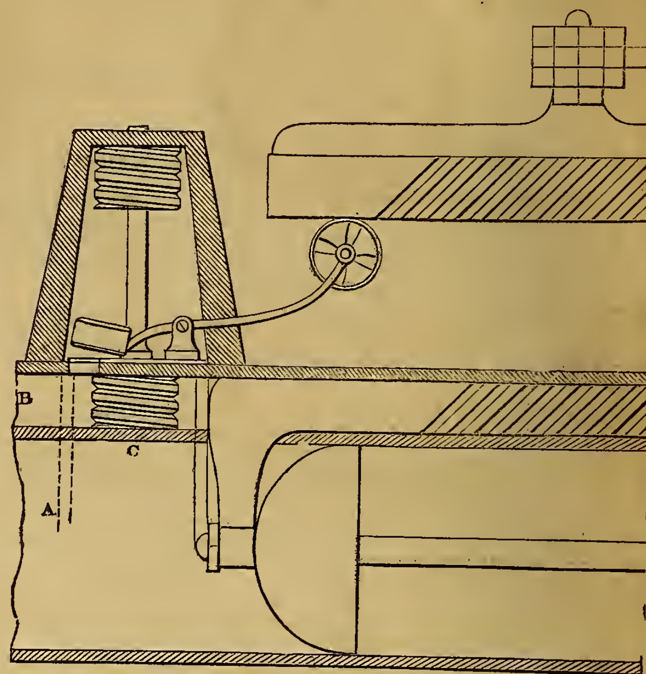



PILBROW.

valve shut, showing the heater in the form of a small cylinder with a depending neck, and the edge view of a wheel for pressing down the valve.

Figs. 5 and 6 are views of Pilhrow's atmospheric railway, in which the longitudinal valve is dispensed with. At each length of ahout 30 feet along the pipe, a pair of shafts are set as shown in the cross section Fig. 5. Upon the upper part of these pinions are set pinions which gear with a rack that travels with the train, and on the under ends of the shafts other pinions are fixed, which gear with a rack that travels in a recess on the top part of the pipe, and is attached to the piston. The teeth of hoth the pinions and racks are ohlique, hut that peculiarity does not affect the mode of action. The piston cannot travel without the rack attached to it turning round the pinions in gear with it, and which are fixed on the shafts; and the shafts cannot revolve without the pinions on their upper ends carrying on the rack with which they gear, and which is affixed to the carriage. The movement

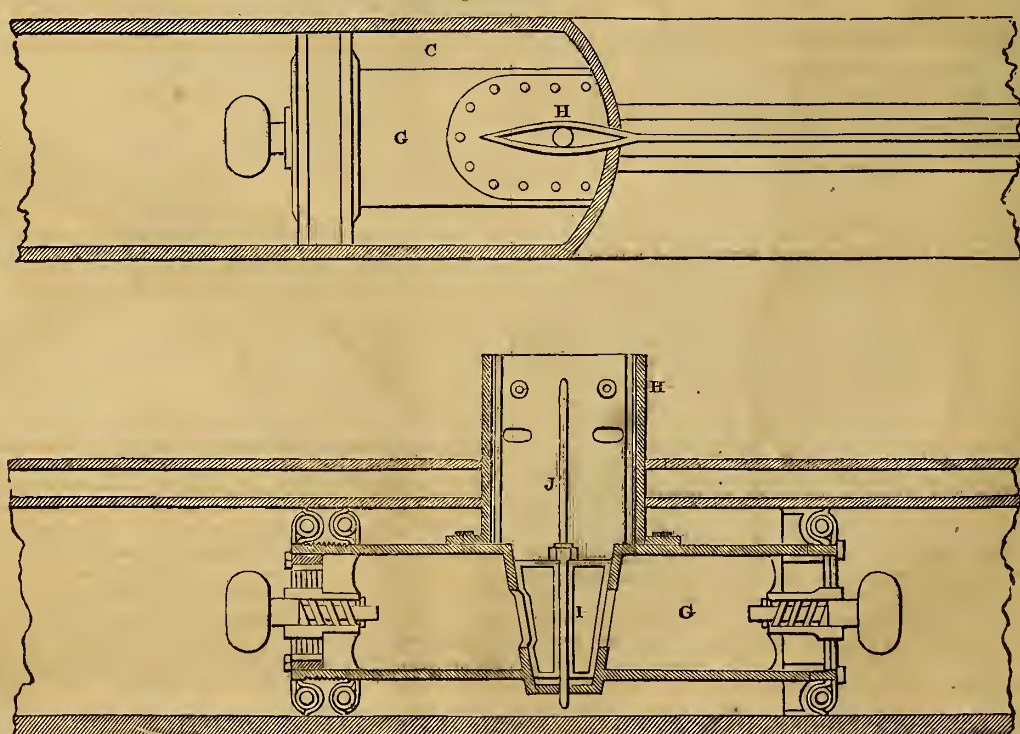
Fig. 6.




PILBROW.

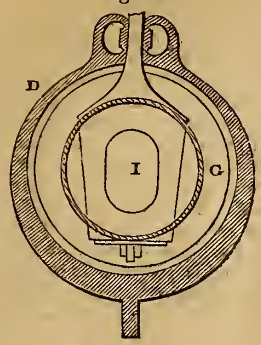
of the piston, therefore, causes the train to move hy employing the intervention of pinions and racks. The train as it moves on opens a series of valves like flute keys, one of which is shown in Fig. 6, with the design of admitting air hehind the piston to press on it with its full force. A, is the tuhe chamher; B the chamber in which the piston rack travels; EE the pinions.

Figs. 7 & 8.



Figs. 7, 8, and 9, are views of Hallette's atmospheric railway. Here the longitudinal slit is kept tight, not by a valve which may be raised, but by means of two lips, as they are termed, shown in Fig. 9, and which consist of

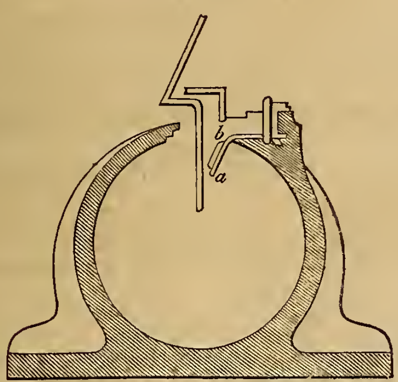
Fig. 9.




HALLETTE.

two inflated flexible tubes inserted in suitable recesses upon the superior part of the pipe. A knife edge hollow arm H, passes up between these lips, connecting the piston G with the carriage; the lips closing behind this hollow arm in its passage, by virtue of the elasticity of the air within them. D, Fig. 9, is the propulsion tube, I, a regulating cock in the piston, by which the impelling force may be destroyed by opening a free communication between the interior of the tube and the atmosphere; J is the handle of this regulating cock. These lips are as suitable for the confinement of compressed air, as for the maintenance of a vacuum.

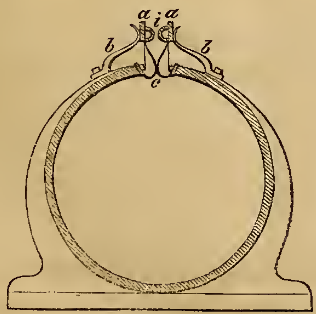
Fig. 10.




PROSSER & CARCANO.

Fig. 10, represents the plan of Messrs. Prosser and Carcano, in which the chief peculiarity is, that the valve *a b* opens inwards. This rail way is intended for compressed air.

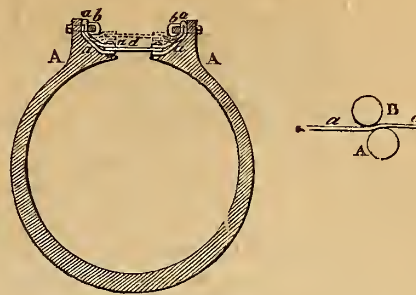
Fig. 11.




TALBOT.

Fig. 11, represents the method of forming the longitudinal valve proposed by Mr. Talbot: *a a* are metal plates supported in their places by the springs *b b*. The dark lines meeting at *c*, represent strips of Indian rubber, which, in ordinary circumstances, and when there is a vacuum within the pipe, maintain the position represented by the dark lines; but when there is no vacuum, and the plates *a a* are iifted up by a bent arm entering at *i*, the Indian rubber strips assume the position shewn by the faint lines.

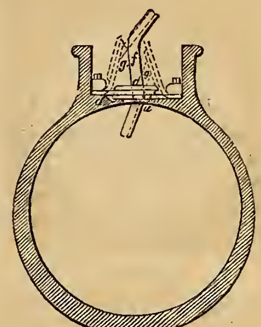
Figs. 12 & 13.




PINKUS.

Figs. 12 and 13 represent a plan contrived by Mr. Pinkus, for enabling the piston within the tube, to carry on the train without any opening in the tube. A A is the tube, and over the longitudinal slit is fitted a steel plate *a a*, the edges of which are secured to the pipe by leather, or other flexible material. The roller A *fig.* 13, is attached to the piston, and the roller B to the train, aud A is so situated within the pipe as to press up the flexible covering of the slit as the piston moves on, B is thus forced onward, and with it the train, for A cannot pass B without lifting it and the carriage to which it is attached, against the power of gravity.

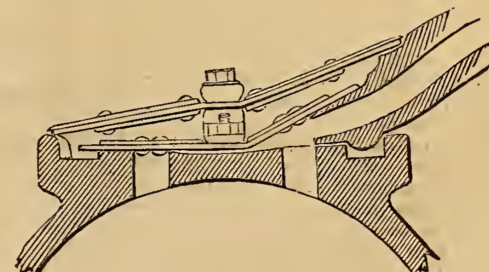
Fig. 14.



PINKUS.

Fig. 14 is another plan by Pinkus, for enabling an atmospheric railway to be worked by compressed air behind the piston, and a vacuum before it: *a*, is the pipe, *dd*, are two flap valves hinged on opposite sides, and falling one over the other: these valves are represented open by the dotted lines at *gg* : *f*, is the arm which connects the piston with the train. The object of the double folding valves is to prevent them from being opened so readily by the compressed air.

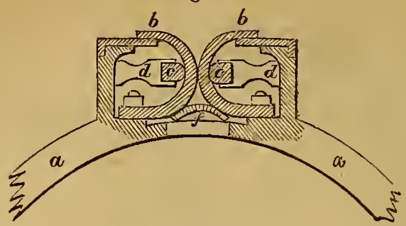
Fig. 15.



PINKUS.

Fig. 15 represents the method contrived by Pinkus for enabling an air locomotive to communicate with a vacuum tube. Here one tube suffices for both lines of rail: the tube, therefore, is betwsen the lines, and on each side of the central line there is a flap valve, protected by a weather board. From the locomotive engine of either line a hollow arm extends to the flap pertaining to that line. This arm is of an elliptical shape, with sharp edges, and it runs on beneath the valve, which it raises in its passage, thus establishing a communication between the air locomotive and the interior of the pipe. The flexibility of the valve enables it to accommodate itself to the elliptical arm in passing, so as to leave no space by which air might enter, and on the under part of the arm is a projection, which runs in the composition intended to keep the flap valve tight. The flap valve is sealed up by this composition at each passage of the train. The slits in the pipe are not continuous slits, but merely oblong holes close to one another.

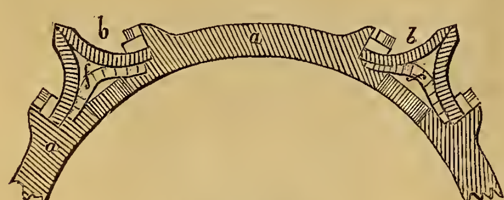
Fig. 16.




PROSSER & BRETT.

Figs. 16 and 17 represent Prosser and Brett's contrivances, for enabling an air locomotive to communicate with a vacuum tube. In Fig. 16, *a a* is the tube; *b b* are pieces of some suitable flexible substance bolted to the pipe; *c c* are rods of wood, which by means of springs *d* help out *b b*; *f* is a perforated iron plate intended to afford support to *b b*, without interfering with the passage of the air.

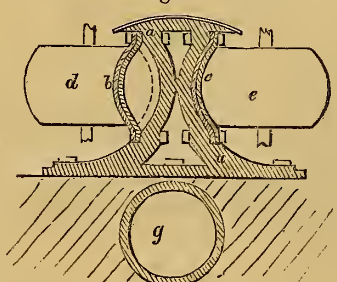
Fig. 17.




PROSSER & BRETT.

In Fig. 17, another modification of the plan is shewn, suitable for working two lines of rail; *a a* is the tube, *b b* are bent steel slips meeting at a point. In both of these arrangements, a hollow arm of which the cross section is elliptical, passes along between the surfaces of the flexible material which are in contact, thereby establishing the cônnection between the air locomotive and the vacuum pipe.

Fig. 18.




NICKEL.

Fig. 18, represents the propelling portion of Nickel's atmosphcric railway, which is identical in its main features with some of the plans previously contrived by Pinkus and others; *a*, is a strong iron flange, cast in lengths, jointed and continued tbroughout the line, forming the inside of cacb tube; *b* and *c* are diaphragms, composed of layers of leather, strong canvass, and *gutta percha*—a newly discovered substance, possessing properties supcrior to caoutchouc. These diaphragms form the outer side of the tubes, which, wben inflated, are elliptical in section; *d*, *e*, are smooth wheels or pinions turning on their perpendicular axes between the wheels, and strongly attached to the driving carriage by suitable frame work. While these tubes remain empty, the wheels *d*, *e*, will press the diapbragms against the flanges, as at *c*, and remain at rest; but, on opening the valve in connection with the pipe *g*, tbe tubes behind the carriage become inflated as at *b*, which, wedging against the wheels, force the train along.

Such are a few of the cbief examples of atmospberic railways; but there are a large number of others, the general features of which we may briefly indicate. *Dembensky's* consists of a single inflated lip for closing the longitudinal slit in the pipe, instead of making use of two, as in Hallette's arrangement. *Hediard's* consists of two steel plates for closing the slit, either inclined to one another, or bent into a semicircular figure—forming springs pressing against each other, with a greasy composition to keep them tight. *Pecqueur's* consists of a small tube divided into short lengths, and set upon the main tube, with spindle or other valves communicating between the large tube and each division of the small one. The large tube is filled with compressed air, which is let into the divisions of the small one, and a hollow arm passes a slit along the top of the small tube, which slit may be closed by any of the various kinds of longitudinal valve. By this arrangement the whole length of thc valve cannot leak, but only one compartment of tbe small, or, as it is called, the distributing tube, can leak at a time. *Chameroi's* plan consists of a number of fixed pistons set along the line above a reservoir pipe for holding compressed air. Upon these pistons a long tube or cylinder, nearly as long as the train, runs, the cylinder being closed at the one end by a suitable valve, which may be moved aside to permit the passage of the pistons. The motion of tbe train opens a valve which permits air to enter between the fixed piston and the cylinder bottom, whereby, tbe piston being fixed, the cylinder is forced on, carrying the train with it. *Labruere* and *Griffiths'* resembles very closely the plan by Pinkus, represented in Fig. 12; and in *Jullien* and *Valerio's* plan there is no longitudinal slit, but the action is intermittent, as in Chameroi's arrangement. In *Mallet's* plan a valvular cord is employed, closely resembling that adopted in Pinkus's first project. *Bodmer's* valve nearly resembles the Λ valve used by Pinkus, or that represented in Fig. 17: he uses leatber however, supported by wood, in the place of steel. In Pinkus's rope arrangement a small stationary air engine is proposed to be used, to give motion to endless ropes, eacb stretching along one-eigbth of a mile, and an arm attached to the train is so contrived that at the end of eacb division of endless rope it lets the rope go, and lays hold of the rope of tbe next division; only one division of rope is thus worked at a time, and the train runs on without interruption from one division to another.

Our limits will not permit us to offer any remarks. on the present occasion, touching the relative merits of these various contrivances, but this task we hope to be able to overtake on an early occasion.

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## ART. II.—TUBULAR SEWERS.

Mr. Simpson, of Edinburgh, whose zealous exertions in every cause calculated to promote the well-being of the working classes, we have already had occasion to notice witb gratitude, bas forwarded to us the results of an experiment he has made, tentative of the efficacy of tubular sewerage, and which are well deserving of attention. Mr. Dyce Guthrie, in his evidence given before the Commission for enquiring into the health of towns, maintained the paradoxical opinion that a very small sewer is preferable to a very large one, inasmuch as in a small sewer, tbe whole of tbe contents are carried off by hydrostatic pressure, whereas in a large sewer, the water alone runs on while the impurities are deposited. A sewer, a foot in diameter, Mr. Guthrie maintained, might be advantageously substituted for one in which, according to the present practice, a man may walk upright: and a tube two and a balf inches in diameter may, in like manner, be substituted for a twelve inch common house drain. Mr. Simpson's house, in Edinburgh, was formerly furnished with a sewer twelve inches square, for which he, some time ago, substituted a cast iron pipe two and a half inches in diameter. After many months' use, this pipe has been examined by Mr. Kirkwood, plumber; Mr. Dyce Guthrie; and Mr. Bryce, architect; and it has been found to be perfectly free from obstruction; thus establishing by a full and fair trial, the sufficiency of the plan. Mr. Simpson remarks, that the supercession of the ordinary species of sewer by tbe self-cleansing kind, will be an improvement that must contribute materially to the public health, for the existing sewers are nothing better than a huge system of branching cesspools, which pollute the atmosphere by their exhalations. The black mud deposited in tbe ordinary sewers has to be removed by hand at a great expense; it is highly volatile, and a mephitic vapour rises from it, even up through the floors of houses—sometimes with such pernicious effects as to occasion great mortality. All this may be carried off by the use of tubular sewers of so moderate a size, that tbey may be flushed full, and a greater efficiency will thus be obtained with a diminished expense.

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## ART. III.—GORDON'S FUMIFIC IMPELLER.

THIS is an engine in which the impelling fluid is smoke instead of steam. Into an air tight fire-place, air is forced by any appropriate contrivance, and by the effluent smoke, which is of course under pressure, an engine is driven. Tbe view we formerly gave represents the arrangement of impeller suitable for raising water, and which will be found closely to resemble Savery's engine. A water wheel, driven by a part of the water raised, is employed to force the air into tbe furnaces, and also to open and close the engine valves at the proper times.

Mr. Gordon states that in ordinary steam engines there is a great loss of power by the hot air whicb escapes up the chimney, and that, inasmucb as the specific heat of air is less than that of water, it is beneficial to use air as a motive agent. To these propositions we believe most engineers will assent, but there is great practical difficulty in employing hot air as a motive power, as, if beated in a retort, tbis vessels liable to be speedily burned out, and in Stirling's air engine, great trouble, we understand, has heen experienced from this cause; while if the air be forced into the fire direct, as in Mr. Gordon's arrangement, the furnace becomes nearly inaccessible on account of the pressure witbin it, and cannot, without mucb difficulty, be supplied with fuel, as the air will rush out whenever the furnace door is opened.

Mr. Gordon proposes to propel a ship by forcing a stream of smoke out at the stern, and railway carriages are to be propelled by a jet of smoke escaping behind, but which is boxed up in a pipe or tunnel, to prevent it from being dissipated sideways. It requires but a very moderate perspicacity to see that these schemes will not do. The velocity of air rushing into the vacuum is about 1338 feet per second, so that if only one atmosphere of pressure be used, the locomotive, in order to obviate loss from slip, would require to move at the rate of about 900 miles an hour, and the pressure answerable to the difference between that speed and the speed realized would be thrown away. The pressure of the effluent air might, it is true, be diminished, whereby the loss by slip would become correspondingly less, but the size of the discharging orifice, and of its enclosing tunnel, would in that case be required to be increased to most inconvenient dimensions. It is needless however to waste more words on such a crudity, and we hardly think that it can add much to Mr. Gordon's repntation to have brought such a project forward.

Such then are the leading points of Gordon's fumific impeller. That the specific heat of air is less than that of water, and that a large loss of heat is consequent on the escape of hot air from the chimney, are facts which cannot be disputed; but that Mr. Gordon has achieved a remedy for the existing evils, may certainly at the least be questioned.

We do not conceive that Mr. Gordon's impeller can in its present form be applied beneficially to any purpose; and although the imperfections may be those of detail only, it is in these details where all the difficulty is concentrated. The whole scheme has an extremely primitive air, and more resembles the device of a tyro in mechanics, than the matured invention of an engineer "known to have no small practical acquaintance with steam engines, machinery, and steam ships, and with an extensive knowledge of pneumatics." The merits of the scheme are set forth in a bombastic Pamphlet in which a penury of sense is sought to be compensated by an exuberance of references to *Ure's Dictionary*, the *Practical Mechanic 'Pocket Guide*, and other similar oricles. Some parts of this Pamphlet are so eloquently wordy, that we can hardly discover what they mean: we extract the concluding paragraph as an exercise for the penetration of your readers, and with it we take leave of Mr. Gordon.

"The public mind opens but slowly to the adoption of any topic so simple and so entirely new as that which I have explained; yet this master movement,—the dynamic action of heat upon solids, liquids, and aeriform bodies,—remains in daily operation, and may be traced in the occurrences of ordinary life. I confidently expect the present generation will see an enlarged application of that agent,—so beneficently committed to man, and that it will roll the tide of truth, of human life, and of human industry, to the most difficult and the most distant sites of our extensive commerce or philanthropic embassage."

## ART. IV.—MUSEUM OF ANTIQUITIES AND GENERAL ARCHITECTURE.

Notwithstanding that the trustees of the British Museum showed themselves averse to the idea of forming a collection of national and mediæval antiquities, when it was suggested to them a couple of years ago by two members of the "Institute," Lord Prudhoe has now reconciled them to the measure, by the offer of his own collection,—an offer by much too good to be refused. So far, all difficulties and objections have been overcome, but there will, we conceive, be some difficulty in providing rooms within the Museum for a distinct gallery of such antiquities, large accessions to which may be expected and must be contemplated, his lordship's donation being merely the nucleus of a future national collection. Either the wings built as official residences must at no very distant time be converted into additional galleries, or a *Branch* British Museum must be erected somewhere else to receive the overflowing treasures of the present one. Should the latter scheme ever be adopted, it might very properly be extended so as to supply a very great desideratum, by the establishment of a national museum both of mediæval antiquities and architecture, and of architecture generally, including an ample collection of models of buildings in various styles, and of varions periods. At present, there is no such collection of models anywhere in this country; one or two things of the kind may be seen for the moment at the Royal Academy's exhibitions, and then all further trace of them is quite lost. Yet, were there any public gallery or museum for the reception of models, many architects who have had their buildings or designs so represented, would, no doubt, very willingly deposit their models permanently in it, or present them to it. Aud such a collection would do as much, perhaps more, for familiarizing the public with architecture, and for promoting a taste for it, than even the buildings themselves.

## ART. V.—AMALGAMATION OF THE ENGINE TRADES.

*An Essay upon the practical advantages to be derived from an amalgamation of the existing Trades' Societies of Engineers, Machinists, and Millwrights.* By a Unionist. 1845.

THIS is an essay which was rewarded with a prize by a committee of engineering artizans, representing several societies which contemplate a union of their members. It is a production of much intelligence, and its general tone displays a spirit of equity and moderation which would do honour to the most exalted station in society. Working men only require to exhibit as much argument and as little heat and intolerance as are here displayed to make the attainment of all just objects of ambition inevitable; whereas, by an appeal to violence and invective, they will gain nothing but obloquy and defeat. Agitate unceasingly is our recommendation—proceed steadily, and circumspectly, and inoffensively—*but proceed.* Let no labour weary, no miscarriage, disgust and no disagreement alienate — but keeping ever before you your high mission, march on regardless of the petty obstructions raised by the petty events of the day. Success ever waits upon well directed perseverance, and success will be yours if ye faint not. We regret that the present essay has come before us so late in the month, that we have neither the time nor the space to do justice to its merits; and we must at present content ourselves with an enumeration of the principal topics it discusses. It is much to be regretted that there should be any necessity of such instruments as trade societies at all, for if the disposition existed on the part of both master and workmen to require nothing but what was equitable, the means of aggression and defence would be alike superfluous; and, if a comprehensive view of the subject be taken, it will be seen, that masters are as much interested as workmen in resisting those inroads upon the rights of labour, which trade societies are established to prevent: for the only effect of yielding to them is to conjure up a system of competition which, without benefiting the master, plunges the workman into misery. The profits of the master, indeed, are curtailed upon *the same amount of work done,* so that with equal risks he is eventually a smaller gainer. In the engine trades, however, it is impossible to prevent injurious competition so long as men can be found in the labour market who will do the required work on almost any terms prescribed; and to remedy this evil, it is necessary that there should be a general union of the engine trades so that the exertions of one section may not be counteracted by the incongruous operations of another. Overtime is one of the pernicious usages which ought to be abated—for the tendency of overtime is to make men work for a greater number of hours for the same amount of pay, while its more obvious operation is to shut working men out from every chance of intellectual improvement and to make fewer men suffice for any given amount of work. But, how can overtime be abolished, or how can masters be asked to bring it to an end, if there be no unanimity among men upon the subject? Working men owe it not only to themselves but their posterity to resist any such insidious encroachments as systematic overtime assuredly is. At a moment of pressure, or in a case of repairs or other accidents, they will, of course, work willingly night and day; but to turn themselves into mere machines of production for a temporary gain, shutting themselves out from all intellectual exercise or recreation, and making creation with its infinite aspects of beauty and unnumbered springs of enjoyment, a dreary waste through which they have to pursue their heavy pilgrimage without respite or consolation—is the part neither of men of spirit, nor men of wisdom. Aad the money gain of over time is but a temporary one, for in the proportion in which the number of working hours is increased, the rate of pay per hour is invariably diminished, so that in the end we have men working an extra number of hours for the same money.

The essayist insists strongly upon the injurious operation of strikes, which he says though they may occasionally be the means of winning some small or temporary advantage, have never yet been productive of any large or permanent amelioration: while the vindictive feelings they call into existence, deprave the heart, impair the judgment, and earn generally for both parties the condemnation of impartial spectators. The wisest steps are rarely taken at a time when the passions are inflamed; and apart from the futility of strikes, they are to be condemned on the ground of being a sort of commercial ambuscade—a tricky device to govern masters by a dilemma—which, to say the least, is not a fair species of warfare. We hear nothing of strikes when there is but little work; but if work becomes brisk, or masters have entered into a contract they are bound to fulfil, then the low advantage is taken to catch employers in a trap. We have raised our voices loud enough, we believe, on the working man's behalf, to prevent the possibility of our sentiments towirds him being mistaken—so loud, indeed, as to have furnished ground of offence, we hear, to some employers, on whose nerves plain speaking grates. But, earnest as we have been in the working man's behalf, and anxious as we are to vindicate his just rights, for strikes we can offer no word of apology; and we look upon their existence as a moral stain which every friend to their prosperity must sedulously endeavour to efface. In a great and hallowed cause like that of the vindication of labour, we must have no small chicane—no recurrence to jesuitical resources; but we must be plain, and fair, and manly, and have no dishonouring blot to sully the coronet of our fame. The essayist suggests the adjustment of the claims of amalgamating societies by fixing upon a given sum per member, as the contribution of each to the general fund—calling upon those societies who have not contributed their proportion to raise the requisite amount among their members, and handing back any excess to the societies possessed of it, to be divided among their members in the just proportions. The establishment of a sick fund is also suggested.

We cannot conclude these hasty remarks without adverting to a principle which has been successfully brought into operation in France, and which, if it could be generally introduced in this country, would heal the breaches now subsisting between masters and workmen, and raise workmen to their just position in society—we allude to the principle of a division of profits whereby workmen participate in a fair proportion of the profits realized by the master. Lord Wallscourt notifies to us, that this principle he has had in operation, on his estates in Ireland, for many years past, with the happiest results. His plan is to set every man down as so much capital, and his estimate of the amount is made in this way. If a man receive thirty shillings a week, or 75*l.* per annum, he is reckoned worth a sum of money that will yield 75*l.* per annnm of interest, at 5 per cent. which is 1,500*l.* He is considered, therefore, as having invested 1,500*l.* in the concern, and he receives the proportion of profit answerable to that sum. If working men would only act their part judiciously, capitalists would soon be forthcoming to aid them with any sum of money upon equitable terms, should the holders of existing factories be unwilling to enter into such an arrangement, We cannot imagine that working men will mar these bright prospects by a recourse to strikes, or other acts of intimidation, by which the investment of capital is discouraged; and without capital, nothing is to be done.

## ART. VI.—ENGINES APPLIED DIRECT TO THE SCREW PROPELLER SHAFT.

WE have seen the designs of several sets of engines in which the motion is communicated direct from the piston to the propeller shaft without the intervention of gearing;—intended for government steamers now in progress of construction. In most of these plans there are four cylinders lying horizontally—two being situated upon each side of the shaft, and in the same plan with it. Both boilers and engines are considerably beneath the water line. The following it appears to us would be a good arrangement: place two short-stroke oscillating engines at an angle of 45° with each other, so that they might both communicate with one crank: make the exterior of the smaller eye of the crank in the form of an eccentric, and to it apply a strap, so as to obtain a stroke shorter than that of the piston for working the air-pump. There may be only one air-pump, which must be double acting: the two foot valves may be superseded by a slide valve worked off the steam valve motion, and the two delivery valves may be supplanted by a piston valve, which is kept opposite the discharge-port by a pendulum, but which will be moved in either direction by the water within the pump, when the pressure suffices to move the pendulum weight. A compact, efficient, and noiseless engine, may, it appears to us, be made by the judicious developement of these suggestions.

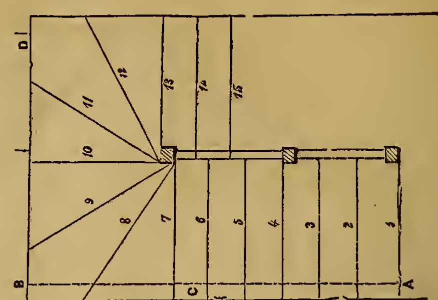
## ART. VII.—THE GUAGE COMMISSION.

The Guage Commissioners are losing themselves in a fog. They are now making experiments with the view of ascertaining whether the wide guage or the narrow guage gives the most economical results—just as if it were their function to determine a nice scientific question, or to fix the best system for a country in which no railways were already made. We are at a loss to comprehend what the use can be of these experiments; the qualities of the two systems, whatever they may be, are certainly more correctly determinable by the results afforded by several years working, than by any holiday experiments these commissioners can try; and such results are accessible to them. In 1838, Messrs. Hawkshaw and Wood reported to the Directors of the Great Western Railway, that they had found the useful load to be in favour of the narrow guage in the ratio of 1.27 to 1; but had the contrary result been established, we do not see in what way that could have effected the present question. We do not want the commissioners to tell us whether the wide guage or the narrow guage is the best, for it is not a new country with which we have to deal; and we already know as much about the merits of the rival guages as the commissioners are likely to tell us; but we want them to say in what way a uniformity of guage may be established, and what the steps are by which they would recommend it to be consummated. It is absurd to treat this as a scientific question: it is a question merely of railway politics which arguments can never reconcile, and it must be disposed of with a view merely to the general advantage. Half measures, or pacificatory expedients of any kind wont do: sliding wheel boxes to transform a narrow into a wide carriage, roller trucks, and other such ingenuities are mere folly and will not do. They have been repeatedly tried and discarded in the colliery railways—they would be unsteady and dangerous, and even, though a narrow guage carriage could be put upon a wide guage railway, the converse of this could not be accomplished, and the communication would be broken even with the use of the rattletraps recommended. It is clear, therefore, that there is no alternative, but to enforce the use of a single guage, and it is equally clear that this guage must be the narrow one, for it is impossible to change narrow guage into wide guage lines without reconstructing the bridges, embankments, and tunnels; whereas, to change the wide into the narrow guage requires merely the relaying of the rails. The commissioners will get into disgrace unless they mend their hand; they appear to be suffering themselves to be bamboozled by the Great Western people, who have an obvious interest in retaining the wide guage on their railway; but with such a desire the public cannot sympathise, and there is only one decision which can be approved or accepted.

## ART. VIII.—STAIR-CASING.

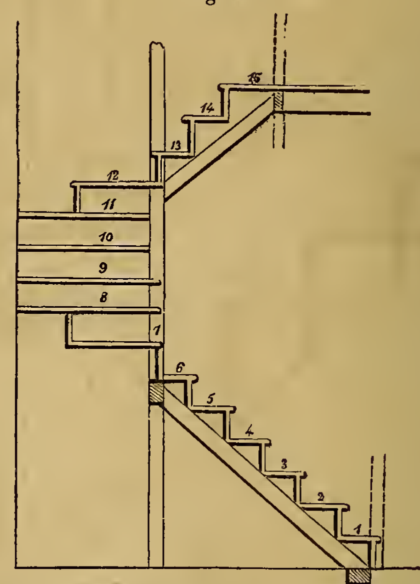
The example which we are about to give of a staircase, is one of very frequent occurrence. It is a plain return staircase without a landing. Fig. 1. is a plan of the stairs, and fig. 2. is an elevation, the string-boards and walls being supposed to be removed. Upon fig. 1. set off, on a rod, the

Fig. 1.



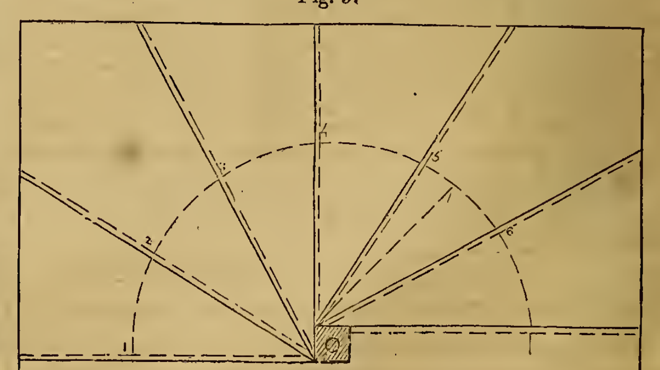
distance from A to B: allow for a moulding round the doorway at A; deduct from C to B for the winders, and divide the remainder into the number of flyers required; upon the other side of the rod, divide the height into the requisite number of risers, as seen in fig. 2.

Fig. 2.



To prepare stairs of this description, straighten the front edge and the under side of tread where the riser is fixed, leaving the top perfectly rough until the step is glued up and blocked, (before which one end of the treads and the riser must be squared:) having done this, plane the top of the tread from which gage the riser to the proper height as marked on the rod: gage a line on the top of the tread as the situation of the next riser; bore holes, to nail or screw it to the said riser from beneath; make the nosing round, and the step is complete; repeat this with all the flyers.

Fig. 3.



Set off the winders as in Fig. 3; those risers which are parallel to the face of the newel being tenoned into it about three-fourths of an inch; bird-mouth each tread to fit round the newel as drawn on the board full size; mark the line of the upper riser on each, and bore nail holes as for the flyers; bevel the ends of the risers, and glue and block them up.

Set off the string-board as shown in Fig. 4, by tacking a straight-edge at the distance *ab* from the top edge, to which apply the longest side of the pitch-board (Fig. 5.), keeping the tread upwards; mark round this, which shows the situation of the first step. The shoulder of the tenon should be at such a distance from the line of the riser as will admit of the face of the newel finishing level with the first nosing; the tenon must not be in the centre, as only one shoulder is requisite.

Fig. 5.


Fig. 7.

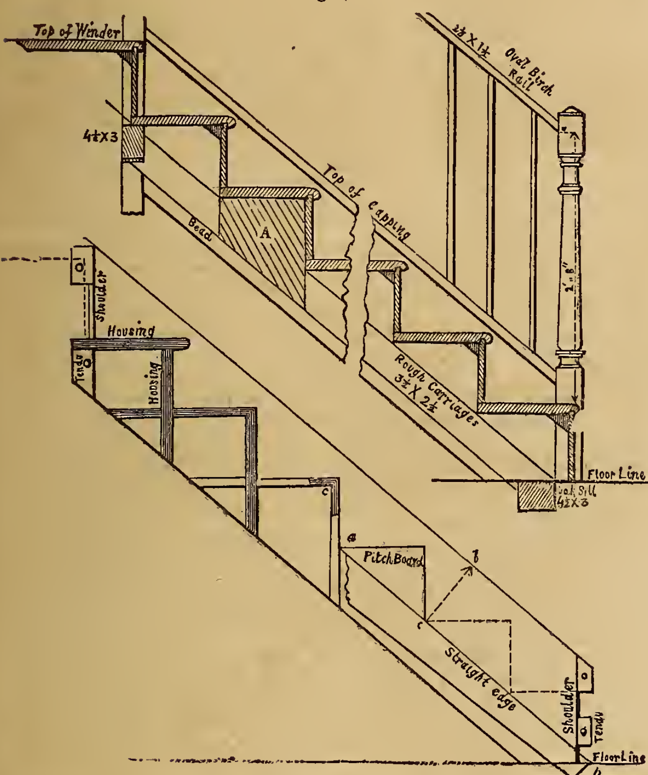
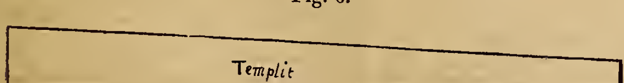



Fig. 4.

Having marked all the steps in this manner, remove the straight-edge and with the templet (Fig. 6.) mark the grooves or housings for the ends of the steps in the string-board; sink about four inches each way, as C. Fig. 1, then cut in the lines with a fine saw the proper depth of the groove, being worked to a line gaged on the lower edge. Having done this, fit the nosing of each of the flyers into its respective groove, keeping the best steps towards the bottom; then lay the string-board flat on the bench, place the upper step in its place, and wedge it fast; repeat this with the next step under it, nailing or screwing it to the upper riser from the under side; the steps being all fixed in this manner, glue on the lower newel (the tenons on each end of the string-board having been previously fitted into their respective newels), and fix the first step; the flight is then ready for fixing. The handrail is of the same length as the string-board, and, like it, must be fitted into the newel and draw-board previous to fixing, and housed in about one-fourth of an inch.

Fig. 6.




To fix these stairs, glue the second newel on the string-broad of the first flight, then place them in their proper position, with the newels perpendicular, and wedge a piece of wood between the wall and string-board, to keep the stairs in their proper plaecs: chalk round the under side of the steps on the wall, and scribe the ends up to the brick work; then take them down, and cut the ends as scribed, and the lines chalked on the wall; give the proper length and position of the rough carriages, which having fixed, lay the stairs in their places, fix the first winder to them by screws from beneath, put a bearer under the middle of it, wedging one end in the wall, and nailing the other to the newel; repeat this with all the winders, then nail brackets similar to A, Fig. 7. Block them to the treads and risers, also block the treads of winders to their respective bearers, fix the rail coping and ballusters, and the staircase is completed. The same method of setting off string-boards applies to those stairs which have a wall string.

Figs. 8 and 9,

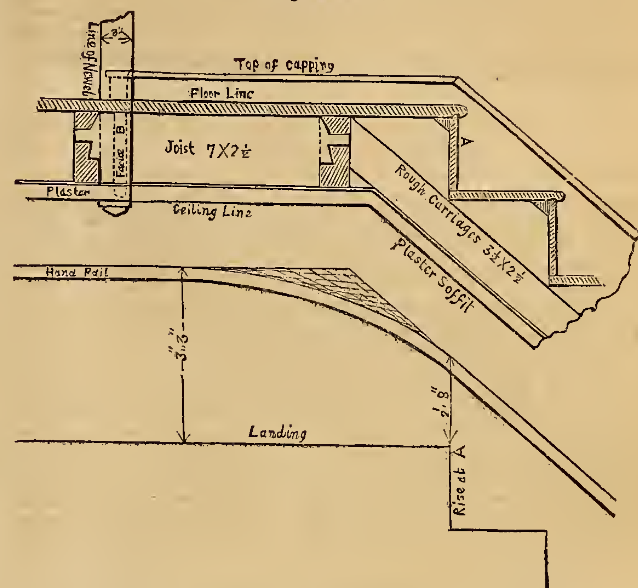



Fig. 8. Exhibits the method of finishing the string-board on the landing, in cases, where the facia B, requires to be fixed fu-ther back than the riser A, to obtain head-room; and Fig. 9, is the method of finishing the rail over Fig. 8.

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## Art. IX.—THE CROYDON ATMOSPHERIC RAILWAY.

This railway has now been effectually tried, and the result has rather exceeded than fallen short of the general expectation. A speed has been realized of at least 60 miles an hour; the various parts of the apparatus have on the whole been found to be easily manageable and convenient. The pipe is 15 inches in diameter, and is exhausted by pairs of 50-horse-power engines, stationed about three miles apart: there are three stations on the line, but it is not found necessary to work the middle station. The ordinary working pressure in front of the piston, at high speeds, is about 24 inches of mercury or 12 lbs. on the square inch, the barometer in the engine room ranging about 27, which shows a difference of about 1½lb. of pressure on the inch, between the two ends of the pipe. The area of the piston in the pipe is above 175 square inches, which multiplied by 12, is equal to 2,100lbs. of tractive force, and this carries 35 tons at the rate of 60 miles an hour. This result apppears to bear out Dr. Lardner's doctrine of the rapid increase in the resistance with the increase of speed; and points to the necessity of making some change, whether in the form of the carriages or otherwise, to abate the loss of power arising from this cause.

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## Art. X.—DEARTH OF ARCHITECTURAL SCULPTURE.

Mr. Lucas's model of the Parthenon, to which we have referred elsewhere, cannot fail of being highly interesting and instructive to the visitors of the British Museum, nor could a more appropriate place have been anywhere found for it than the Elgin Room, that being the depository of the relics of the sculpture which once adorned the Athenian fane. Still, it will at the same time reproach the Museum itself—that is, Sir Robert Smike's building, which will be so far from being, à la Parthenon, arrayed externally in all the pomp of sculpture, that it will not have the slightest decoration of he kind at all. We imagine, therefore, Sir Robert was not concer ed in trecommending the Trustees to purchase Mr. Lucas' model. He nas no fancy for cutting out work for sculptores. The only sculpture or hrving which he introduces, is confined to columns—their capitals and catings, which are mere mechanic beautis that are purchasable by the yard. In the excessive simplicity of his taste, he rejects even carved mouldings of any kind; consequently. our sculptors are not at all likely to vote bim a gold medal in grateful acknowledgment of the abundant employment he will have provided for them in his structure for tbe British Museum. Indeed, the prevailing architectural vice is, to crop architecture of its ornaments, and to distinguish the resulting piece of baldness as a chaste and classical combination. A modern architect would be horror-stricken, if it were proposed to range brazen shields upon the structures, or to make use of colour or other such illegitimate resources. But tbe model of the Parthenon shews that the Greeks had no such fastidiousness, and suggests the belief that architecture is at present held in the same state of slavery by precedent, that philosophy was held in a few centuries ago by the dogmas of Aristotle. The next generation of architects will break through this bondage—the engineers will get among them, and first shock. and next electrify the finical race with their cast iron orders, and other heteredox innovations.

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## Art.—XI—NOVELTIES IN ART AND SCIENCE.

*Application of Photography in Astronomy.*—At the time the art of Photography was discovered its applicability to astronomical uses, was suggested by Professor Nicholl, of Glasgow, and others, but up to the present time, we are not aware of any successful results having been attained with that object. Recently however in Italy, photographic maps have been made of tbe heavens, and the forms of the nebulae have been transferred to a photographic stone and from thence to paper. The nucleus of the nebula of Andromeda, was subjected to a magnifying power of eight hundred and twenty-four, and tben daguerrotyped. By this process it was resolved into a great number of luminous points; these by the application of a higher magnifying power may turn out to be stars. There is no limit to the magnifying power by this process, for a magnified daguerrotype image, may be illuminated, and again magnified, and the image thus obtained may be illuminated, and magnified, in its turn.

*The New Iron War Steamer, Trident.*—This vessel, which has just been launched from Messrs. Ditchburn and Mares' building yard, is of the following dimensions:—

| | | |
|---|---|---|
| Length, over all ... ... ... ... ... | 200 ft. | 0 in. |
| Length, between the perpendiculars ... ... | 180 | 0 |
| Length of the Engine-room ... ... ... | 45 | 0 |
| Breadth of Beam ... ... ... ... ... | 31 | 6 |
| Breadth over all ... ... ... ... ... | 52 | 6 |
| Depth in Hold ... ... ... ... ... | 18 | 0 |

Burthen, in Tons, 900.

We have inspected this vessel on several occasions during her construction, and are able to say that the scantlings are abundantly strong, and the vessel is well put together. The frames or ribs are *double, each rib* being composed of two angle-irons, 4 inches by $3\frac{1}{2}$ inches, by $\frac{1}{2}$ incb thick, rivetted together, and in one entire length, from the gunwale to the keel; there being of these double ribs 270 pairs. The iron skin is $\frac{5}{8}$ inch thick at the keel, diminishing upwards at tbe gunwale to $\frac{1}{2}$ inch. The weight of the hull is 380 tons. The total weight of the ship, with her machinery, coals, water, guns, and stores for sea-going, is calculated at 900 tons. The load waterline stands at 10 feet 9 inches, and the light or launching draught of water, at 6 feet 3 inches. The cost of the hull, with the machinery, as contracted, is 31,000*l.* The principal armament is to consist of two long swivel guns of ten incb bore, one forward and one aft, to fire in line of keel, and four 32-pounder broadside guns. The engines are of the oscillating plan, and the boilers are tubular,—and both are by Messrs. Boulton and Watt.

*New Experiments upon the Properties of Steam.*—An important paper has just been read by M. Regnault before the Paris Academy of Science, relative to his experiments on steam. The Minister of Public Works assisted M. Regnault with the means of making these experiments on an extensive and practical scale. The questions to be determined by M. Regnault, were—1. The law which unites the temperatures and elastic powers of aqueous vapour at saturation. 2. The quantity of heat absorbed by a kilogramme of water at 0 degree, to be converted into steam of saturation at different degrees of pressure. 3. The quantity of heat absorbed by the same quantity of water in order to raise the temperature to the point in which it assumes the state of vapour under different pressures. 4. The specific heat of aqueous vapour at different stages of density, and at different degrees of temperature. 5. The co-efficients of dilatation of aqueous vapour in different stages of density. In his present paper M. Regnault gives the law of the elastic powers of steam up to 230 degrees centigrade, which temperature corresponds to 28 atmospheres and a half. He next fixes the total heat of steam taken at different pressures, from 1-5th to 15 atmospheres, and finally, he treats of the calorific capacity of water from 0 to 190 degrees. Many distinguished men have devoted their attention to the elastic powers of steam. Among whom are—Achard, Greu, Dalton, Christian, Arzberger, Watt, Robinson, Betancourt, Schmidt, Southern, Ure, Gay-Lussac, August, Kaemtz, Dulong and Arago, the two latter of whom commenced their experiments in 1823, at the request of the Minister of the Interior, and published an account of them in 1829. They carried their operations up to 25 atmospheres. About the same period a commission of scientific Americans performed a series of experiments on this subject, but went up only to 10 atmospheres. The results, however, of these different experiments were not alike, consequently, M. Regnault had to take entirely new ground, greatly aided however, by the progress which science has made since the period alluded to. In his results he agrees most with MM. Dulong and Arago, particularly as regards high rates of pressure. Watt had supposed that the total quantity of heat necessary for tbe transformation of a kilogramme of water into the state of steam was a constant quantity at all pressures, being represented by 650. M. Regnault, however, has ascertained that this number increases constantly from 622 under the pressure of one-fifth of an atmosphere up to 670 under 15 atmospheres. At the ordinary pressure the average of 38 experiments gives 636, 37. As to the calorific capacity of water, it is 1,000 between 0 and 30 degrees, 1,005 between 30 and 120, 1,013 between 120 and 190.

*Artificial Ultra-marine.*—Robiquet's process for the production of artificial Ultra-marine, consists in heating to low redness a mixture of one part porcelain clay, one and a half sulpbur, and one and a half parts anhydrous carbonate of soda, either in an earthenware retort or covered crucible, so long as vapours are given off. When opened, the crucible usually contains a spongy mass of a dark blue colour, containing more or less ultra-marine mixed with the excess of sulphur employed, and some unaltereed lay and soda. The soluble matter is removed by washing, aud the ultre-marine separated from the other impurities by levigation. The mauufacture of ltra-marine is well worthy of the attention of English manufaturing chemists the chief expense is the fuel, and that in England, is of less importance than in any other country.

*Cure of Aneurism by Electricity.*—It has long been known tbat when an electric current is passed through an egg, tbe albumen is coagulated. It has occurred to the surgeon of the Hotel Dieu, in Lyons, that aneurism might be cured by passing an electric current through it, which would coagulate the albumen of the blood; and on testing this idea, it was found to be a just one. The mode of operating is as follows:—The blood is first stagnated by pressing the artery, then two puncturing needles are thrust into the tumour, which communicate with the pile. These two needles ought to be covered with an isolating varnish, in order as much as possible to avoid the loss of electricity in traversing the tissues, and especially the irritation and pain which it occasions. They must have a point of contact, and it is round tbis point that the albuminous masses form, which tbe operator ougbt to multiply in the interior by moving the needles. The pile ought not to be very active.

*Leviathan Spinning Mill.*—An American paper states that a new spinning factory, now in course of erection at Portsmouth, in the United States, i the largest structure of tbe kind in the world. The building consists of a centre 204 feet long, and two wings, each 150 feet long. The centre part is to be six stories high, the wings five stories; height of the lower story 13 feet, of the other stories 12 feet; the length of tbe front will be 504 feet, or about a tenth of a mile. There will be about four acres of flooring in the Portsmouth factory. Number of spindles, 50,000; number of operatives 1,200 to 1,500. In the rear two parallel buildings, two stories higb, will be extended 100 feet back from the junction of the main building with the wings; and between those buildings, 50 feet from the main structure, the boiler-house is to be erected. Tbe foundation of tbe cbimney, which is to be 140 feet bigh, is laid, and is in progress of erection.

*New Planet or Comet,*—M. Hencke of Driessen has discovered a new star, the nature of which has not yet been determined. It is of tbe 9th magnitude, and as its place in the heavens is not readily found, Sir James South has given the following directions for finding it:—The stars in the head of the constellation Taurus resemble the letter "V." and which, when they are on the meridian (as they now are at about 10 o'clock at night), is inclined to the horizon at an angle of about 30 degrees. The lower side of the V is bounded by tbe magnificent star Aldebaran to tbe left, and by Gamma Tauri to the right; whilst the upper side is formed of Epsilon Tauri on the left, and Gamma Tauri on the right. Between Aldebaran and Gamma is a group of stars composed of the two Thetas, and others, whilst the three Deltas and others are similarly situated in the upper side, each group being nearly in the centre of its respective side,— circumstances to be borne in mind, lest one side be taken for the other, as I have frequently seen done when a night glass bas been the telescope in use. Direct, then, a night glass to tbe group of stars in the lower side of the V. so that Aldebaran and Gamma Tauri be seen on the lower part of tbe field on the left, and fix upon a point which shall make with them an equilateral triangle, the apex of which shall point upwards, and that is the spot where Mr Hencke saw his star.

*Method of making Salt Water Fresh.*—Dr. Polli, of Milan, has communicated to the scientific congress, at Naples, a metbod of making salt water fresh by means of electricty. We have considerable doubts whether the means suggested will be simplei than distillation.

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[Art. xii.—THE SOCIETIES.

Royal Society.—*Extraordinary Discovery in Light, by Mr. Faraday.* —At a late meeting of this society, Mr. Faraday's paper "On the Magnetization of Light, and the Illumination of Magnetic Lines of Force," was read. For a long time past the author had felt a strong persuasion, derived from philosophical considerations, that among the several powers of nature which, in their various forms of operation on matter, produce different classes of effects, there exists an intimate relation; that they are connected by a common origin, have a reciprocal dependence on one another, and are capable, under certain conditions, of being converted the one into the other. Already have electricity and magnetism afforded evidence of this mutual convertibility; and, in extending his views to a wider sphere, the author became convinced that these powers must have relations with light also. Until lately his endeavours to detect these relations were unsuccessful; but at length, on instituting a more searching interrogation of nature, he arrived at the discovery recorded in his paper, namely, that a ray of light may be electrified and magnetized, and that lines of magnetic force may be rendered luminous.

The fundamental experiment revealing this new and important fact, which establishes a link of connexion between the great departments of nature, is the following:— A ray of light issuing from an argand lamp is first polarized in the horizontal plane by reflection from a glass mirror, and then made to pass for a certain space through glass composed of silicated borate of lead, on its emergence from which it is viewed through a Nichol's eyepiece, capable of revolving on a horizontal axis, so as to interrupt the ray, or allow it to be transmitted alternately, in the different phases of its revolution. The glass through which the ray passes, and which the author terms the dimagnetic, is placed between the two poles of a powerful electro-magnet arranged in such a position as that the line of magnetic forces resulting from their combined action shall coincide with, or differ but little from, the course of the ray in its passage through the glass. It was then found that if the eyepiece had been so turned as to render the ray invisible to the observer looking through the eyepiece before the electric current had been established, it becomes visible whenever, by the completion of the circuit, the magnetic force is in operation; but instantly becomes again invisible on the cessation of that force by the interruption of the circuit. Further investigation showed that the magnetic action caused the plane of polarization of the polarized ray to rotate; for the ray was again rendered visible by turning the eyepiece to a certain extent; and that the direction of the rotation impressed upon the ray when the magnetic influence was issuing from the south pole, and proceeding in the same direction as the polarized ray, was right-handed, or similar to that of the motion of the hands of a watch, as estimated by an observer at the eyepiece. The direction in which the rotation takes place will, of course, be reversed by reversing either the course of the ray or the poles of the magnet. Hence it follows that the polarized ray is made to rotate in the same direction as the currents of positive electricity are circulating, both in the helices composing the electro-magnet, and also as the hypothetical currents which, according to Ampére's theory, circulate in the substance of a steel magnet. The rotatory action was found to be always directly proportional to the intensity of the magnetic force, but not to that of the electric current; and also to be proportional to the length of that portion of the ray which receives the influence. The interposition of substances which occasion no disturbance of the magnetic forces produced no change in these effects. Magnets consisting only of electric helices acted with less power than when armed with iron, and in which magnetic action was consequently more strongly developed.

The author pursues the inquiry by varying in a great number of ways the circumstances in which this newly-discovered influence is exerted; and finds that the modifications thus introduced in the results are all explicable by reference to the general law above stated. Thus the effect is produced, though in a less degree, when the polarised ray is subjected to the action of an ordinary magnet, instead of one that derives its power from a voltaic current; and it is also weaker when a single pole only is employed. It is, on the other hand, increased by the addition of a hollow cylinder of iron, placed within the helix, the polarised ray traversing its axis being then acted upon with great energy. Helices act with equal power in any part of the cylindric space which they enclose. The heavy glass used in these experiments was found to possess in itself no specific magneto-inductive action.

Different media differ extremely in the degree in which they are capable of exerting the rotatory power over a polarised ray of light. It is a power which has no apparent relation to the other physical properties, whether chemical or mechanical, of these bodies. Yet, however it may differ in its degree, it is always the same in kind; the rotation it effects is invariably in one direction; dependent, however, on the direction of the ray and of the magnetic force. In this respect it differs essentially from the rotatory power naturally possessed by many bodies, such as quartz, sugar, oil of turpentine, &c., which exhibit the phenomena of circular polarisation; for in some of those the rotation takes place to the right, and in others to the left. When, therefore, such substances are employed as dimagnetics, the natural and the superinduced powers tend to produce either the same or opposite rotations; and the resulting effects are modified according as they are cumulative in the former case, and differential in the latter.

In the concluding section of the paper the author enters into general considerations on the nature of the newly-discovered power of electricity and magnetism over light, and remarks that all these powers possess in common a quality of character which constitutes them a peculiar class, and affords an opening, which before was wanting, for the application of these powers to the investigation of this and other radiant agencies. The phenomena thus brought to light confirm the views entertained by the author relative to the constitution of matter as being spheres of power, for the operation of which the conception of a solid nucleus is not necessary; and leads to the presumption that the influence of magnetism on bodies which exhibit no magnetic properties consists in producing in them a state of electric tension tending to a current; while on iron, nickel, and other bodies susceptible of magnetism, currents are actually established by the same influence.

Society of Arts.—*Improvements in Locomotive Engines.*—The meetings of this Society have again commenced, and with the promise of increased prosperity, various improved arrangements having been effected. The first communication read to the society was a paper on certain improvements in constructing the locomotive engines and permanent way of railways, with reference to the question of wide and narrow gauge, by Mr. J. G. Bodmer, formerly of Manchester, now of London. In this paper the author examines the question of the relative merits of wide and narrow guage; he ascertains that the question is not one either of relative safety or danger, but that it resolves itself ultimately into this enquiry:—which gauge will admit of the most perfect means for obtaining high velocities with greater regularity and economy? At present, he admits, the broad gauge has the advantage in more powerful and speedy engines. But he then proceeded to shew that by placing the *cylinders outside*, and by *increasing* the fire box and flue surface in the manner he proposes, and by adopting the principle of compensation as in his double piston locomotives, high velocities may be obtained with security, safety, and advantage. In short, that as powerful an engine in every way may be placed on the narrow gauge as on the wide one, and one equally well adapted to high velocities. He then went on to shew how the chief limit to increase of power, and the corresponding increase of weight in locomotive engines, consist not so much in the construction of the engines as in obtaining a permanent way, suitable for the support of such enormous loads. By these loads travelling at high velocities, concussions are produced, which derange the permanent way, and are at present the chief sources of danger and cost, and the chief limit to the speed. He approves of the triangular sleeper originally invented by Reynolds, and he proposes to use a modification of that on a larger scale as a longitudinal bearing. He also proposes that the breadth of the rail should be so increased as to diminish the continual attrition so destructive to wheels, and procure greater durability. In the conclusion of the paper he suggests that an experimental railway ought to be constructed, either at the expense of the Government or of the joint railways, for ascertaining the best means for giving the increased velocity, which the public are beginning to demand, in the best manner. The paper gave rise to a long discussion, which elicited the opinions of engineers and scientific men present, on the merits of Mr. Bodmer's plan. The next paper read was a sequel to the former, by the same author, on improved crank axles and axle boxes, by which greater security and economy are obtained in railway trains running at high velocities.

Institute of British Architects. — *Royal Exchange.* — Mr. Tite proceeded to read a paper 'On the Original Foundation and Erection of the Royal Exchange, by Sir Thomas Gresham, with some Notices of the late Building destroyed by Fire, and an Account of the Roman Antiquities discovered in excavating for the Present Edifice.' The first branch of his subject Mr. Tite illustrated by numerous extracts from the records, of which the corporation of London possess a rich collection, commencing with the original charter granted to the city by William the Conqueror, a document which he incidentally describes as being comprised in a few lines in the Anglo-Saxon language. Coming then, to the authorities more immediately connected with the subject, Mr. Tite detailed the transactions relating to the building of the Royal Exchange, through the munificence of the princely merchant, by whom the whole expense of the structure was undertaken, on condition that the site should be provided by the City, from his first proposal to that effect in 1564. The purchase of the site cost the citizens 3,532*l.* 17*s.* 2*d.*, including freeholds, leaseholds, and tenants' interests; and it is to be noted that the former class of property realized about twenty-three years' purchase—a value not very different from the average of later times. The building was completed and opened for use in 1567. During the progress of the work, a question appears to have arisen between Sir Thomas and the city respecting the *property* in the building, which terminated in his assuring, after his own life, half the profit of the shops and other tenements to the Corporation, and half to the Mercers' Company; and it is from this division that the affairs of the Exchange have always been in the hands of the mixed body called the Gresham Committee. The appearance of the original building is preserved to us in Hollar's engraving, which shows it to have been in a much better style of architecture than the Bourse of Antwerp, of which it has been pretended it was a copy. That of Amsterdam bears a much greater resemblance to it, but in this case the London building is the original, and not the copy; that of Amsterdam dated only from 1612. Shortly after the death of Sir Thomas Gresham, some part of the building failed, upon which occasion the members of the Corporation endeavoured to cast the repairs upon the widow of their benefactor. From a report made by the Gresham Committee, after the destruction of the building in the great fire, it appears that the arcades of the court were vaulted with stone, and that it had been necessary to stay the supporting pillars by transverse iron ties. This report is dated on the 17th September, 1666, so that the committee had lost no time in taking measures to repair the calamity they had suffered. Estimates for the new building were speedily provided by Messrs. Mills and Jerman, who appear to have proceeded in the plan of making out quantities, and giving them to the tradesmen to be priced. After some coquetting on the part of the latter, who professed to deprecate any interference with the office of city surveyor, held by Mills, Jerman was at last appointed the architect, and the first stone of the new edifice was laid by King Charles II., on the 23d of October, 1667. In erecting the new edifice, the site was considerably enlarged, and it was the wish of the citizens to disengage the building from the houses, late Sweeting's Alley, which pressed upon it to the eastward, encouraged by an offer of the proprietor, Sweeting, to dispose of his property on the most liberal terms, and which ended, as such offers usually do, in demands too exorbitant to be complied with. The tower of Jerman's building, which, from motives of economy, was constructed of timber instead of stone, yielded to the effects of time in 1818, and was replaced by a stone cupola, designed by William George Smith. With reference to the building lately completed under his superintendence, Mr. Tite confined himself to the antiquities. Four glass cases, containing a numerous selection, were laid on the table, consisting of pottery, coins, writing-tablets and styles, a great variety of objects in metal, and a quantity of shoes and sandals in excellent preservation. The whole of these curious objects were found in one spot, at a depth below the general level of the solid ground, and bedded in black mud—evidence that it had been a pond, and the receptable of rubbish for the neighbourhood during the period of Roman London.

BRITISH ARCHÆOLOGICAL ASSOCIATION, Dec. 17.—The most important part of the proceedings of this evening was furnished by Mr. W. H. Brooke, of Hastings, on some ancient paintings, in fresco or distemper, recently discovered on the interior of the walls of Battle Church. The extent of these mural decorations may be imagined from the number of illustrative drawings which accompanied Mr. Brooke's report. They amounted to thirteen, exclusive of architectural plans and sketches. The paintings are divided into several subjects, comprising the overthrow of Satan by the Archangel Michael, the trial and condemnation of our Saviour, figures of saints, abbots, &c., female saints decorated with a crown or nimbus, and holding missals, thuribles, palm branches, &c., a group intended for a "memento mori," with an epitaph from Lucan—*Mors sceptra ligonibus æquat;* a representation of baptism or confirmation, and many which have been so defaced in former times by Puritans, and in modern days by beautifying churchwardens, as to be almost unintelligible. Many are in a superior style of art, exhibiting careful and correct drawing; some of the figures in particular are anatomically good, and the drapery is tasteful and classically graceful. All the personages represented are in the costume of the period of the execution of the paintings; thus Pilate is arrayed as an English prince, and the attendants as Norman soldiers. There is a remarkable similarity in the scourging post to which Christ is about to be lashed, to one carved on the font of the old church of St. Clement, Hastings. Mr. Brooke, upon comparison of these paintings with some discovered about fifteen years since in Preston Church, near Brighton, is inclined to attribute them to the same artist, and to the latter part of the thirteenth century. Mr. Croker read a paper, by Mr. Cuming, on some pilgrims' signs and leaden tokens, or medalets discovered in making excavations for new London-bridge. Mr. Charles Warne exhibited some Celtic or Belgic bronze weapons, discovered in a large barrow near Came, Dorset; and Mr. Planche announced that fresh discoveries, made at Lewes, would be detailed at the next meeting. M. Guizot, M. Victor Hugo, le Baron Walkenaer, M. Leuormant, le Vicomte de Santárem, le Comte Auguste de Bastard, le Baron Taylor, M. Lassus, and M. Letronne were elected members of the association.

ASIATIC SOCIETY, Dec. 6.—The reading of Mr. Masson's paper, "On the Route of Isidorus of Charax, from Seleucia to Ecbatana," was continued. The route comprised the locality of Bagistanon—the Behistún, or Besitún of the modern Persians, the site of the celebrated rocks covered with sculptures and inscriptions in the cuneiform character, which have so long excited the attention of the learned, and which have finally yielded to the persevering researches of Major Rawlinson, now resident at Bagdad. Portions of the results of Major Rawlinson's labours have been read, from time to time, at the meetings of the society; and a few days before the present meeting, the whole of Major Rawlinson's drawings and translations of these ancient monuments arrived in London from Bagdad and were exhibited. Mr. Masson's paper showed that the Bagistan of Darius, or Bagistanon of Diodorus, was the Bisitún of the modern Persians, confirming the identification by the true name of the place, Behistún, as demonstrated by Major Rawlinson. Mr. Masson describes the successive sculptures upon these rocks, from those partially obliterated; which he thinks may be attributed to Semiramis, and which appear to have escaped the observation of former travellers, down to those of the recent Sassanian princes. There is an inscription in letters of extraordinary size, formed of squares and circles, above the supposed sculptures of Semiramis. Mr. Masson much regrets that he did not copy this inscription, which, like the sculptures, appears to have escaped other observers: his time was very limited; and he confesses he was not then alive to their value. He is inclined to suppose that they may comprise the Syrian inscription of Semiramis, mentioned by Diodorus, recording her ascent to the top of the rock, upon the mountain of fardels and packs from the mules which followed her army.

DECORATIVE ART SOCIETY.—*Chromatic Decorations.*—A paper "On Chromatic Decorations in England," was read by Mr. E. Cooper. He commenced by noticing the progressive regard for coloured decorations exhibited during the Norman and Gothic epochs; alluding to the simple and chaste effect produced by the polished Purbeck marble shaft at Ely, and the Temple Church, the rich grandeur of the earlier stained glass windows at York and elsewhere; with the attendant painted decorations on ceilings and walls, and the pavements of encaustic tiles. He attempted to elucidate the principles which predominate in the better examples, by explaining the general application of the three primary colours, and the more usual construction of the designs. He then noticed the stained glass windows at King's College, Cambridge, where the whole of the subject and detail are designed with a feeling of renaissance (it is supposed by Giulio Romano); he said, from personal observation, that nearly all the coloured glass is what is technically termed pot-metal, so that where it is not so, as probably in the finest colours, it is enamelled glass; and he observed that drawing and shading were placed upon these, as is evident from the disappearance, in many cases, leaving the pot-metal only. A *disconsonance* was alluded to, arising from the colours of background and fore-ground in pictorial subjects being of the same intensity; and a method of producing light and distance by removing more or less from the thickness of the enamel was suggested as applicable to windows, and a specimen was exhibited. Mr. Cooper then commented on the agreeable effect of stained glass windows when the walls are of a simple or uniform colour, but urged careful consideration when the walls are decorated with pictures. He observed that the altar-piece at King's College is entirely neutralized in effect by the overwhelming coloured rays of light entering in every direction upon it; the earlier examples of Gothic windows were said to allow the transmission of a greater proportion of pure light. He maintained that the ancient coloured glass had no superiority over that now produceable, and that the prevalent opinion of inferiority had arisen from the greater use of *painted,* instead of *pot-metal or enamelled glass.* After some remarks on encaustic tiles (from specimens from Reading Abbey), and the peculiarities of Gothic drawing, colouring, and sculpture, Mr. Cooper described some examples of transition, or mixed Gothic and Italian character, in the ceilings of the Chapel Royal, St. James's, and the chapel of Bishop West, in Ely Cathedral; also the fine specimens of baronial decorations lately restored at Hampton Court. He then took occasion to censure the manner in which some of the coloured decorations in the spandrils below the windows of the aisles in Westminster Abbey have been destroyed or concealed by misplaced and absurd mythological monumental tablets; and he noticed some fine and well known examples of "high tombs," richly ornamented with marble, colour, and gilding. The decorations of the Elizabethan period were noticed, and a specimen of embossed, silvered and coloured leather hangings from the Manor House, Billingshurst, was exhibited. The introduction of Italian architecture, by Charles, led to the consideration of the ceiling of the Banquetting House, Whitehall, painted by Rubens, also of the works by Thornhill, Verrio, Languerre, and Charles de la Fosse at Greenwich Hospital, St. Paul's, Chatsworth, and Montague House (late British Museum). At present, he remarked, there appears to be a struggle for supremacy between the Gothic and Italian styles; and, in his criticisms on some recent decorations, Mr. Cooper expressed an opinion that the imitations have been unsuccessfully applied, instancing those in the Temple Church as partaking too freely of yellow ochreous tints, the Royal Exchange as being too *petite* and paltry for their purpose, the Conservative Club as presenting a bewildering profusion of trifling ornaments devoid of any important character or design, and materially diminishing any grand effect that the architects might have contemplated. After some remarks explanatory of his views on domestic decorations of the present day, Mr. Cooper submitted a question as to the applicability of *Gothic decorations to modern purposes,* with more especial reference to the New Palace of Westminster; he admitted that decorations should be in accordance with the style, and subservient to the architectural character of the edifice; but, he asked, Must we therefore follow the earlier Gothic mannerisms? Copy the attempts of an age of comparative barbarism in Art? Or, are we to adopt all the improvements and knowledge of form of the present day? He contended that the Gothic did not admit of pictorial decoration in proper keeping, and that the modern school of painting presented too many inconsistencies. He concluded by asserting that the Italian style of the fifteenth and sixteenth centuries, as found in the designs of Palladio, Scamosi, Sansovino, and others, admitted of the utmost degree of refinement, both in sculpture and painting, and afforded profitable materials for study for such a purpose.

## ART XIII.—REPORTS.

### REPORT BY MR. FAIRBAIRN, OF MANCHESTER, ON THE BOILER EXPLOSION AT BOLTON.

A GREAT variety of opinion exists as to the causes of the explosion and bursting of steam-boilers, and men of science even are not agreed as to whether they take place from excessive pressure due to the sudden accumulation of heat, and a surplus quantity of steam, or from some other cause, such as the ignition of hydrogen gas, generated by the decomposition of water thrown upon heated plates. The latter is a very prevalent opinion, but I apprehend it cannot be the true cause, inasmuch as we must assume the boiler to be nearly empty of water, and a considerable number of the plates immediately over the furnace red hot.

It is not unreasonable to suppose that a force of such sudden origin, and so immediate and destructive in its effects, should suggest the presence of an explosive mixture; but I think it would be difficnlt, if not impossible, to account for the accumulation of a sufficient quantity of hydrogen to cause explosion, without the presence of oxygen or atmospheric air. Now, as atmospheric air cannot be introduced into a boiler so situated, we are bound entirely to discard this notion, and to look for some other more satisfactory reason for the fatal and destructive accidents which of late years have become so frequent.

Inquiries were made into this subject some years since, and from a series of experiments it was found that, exclusive of the great difficulty which existed in generating hydrogen in a steam-boiler, it could never cause explosion without its equivalent of oxygen, aud even this explosive compound would not take fire when saturated with seven-tenths, or upwards, of its own volume of steam. From these experiments, and from those of a more elaborate character (undertaken by the Franklin Institute at the request of the American Government), we may infer that no explosion could take place, even if an explosive mixture was found in the boiler, unless its volume were at least double that of the steam, which under any circumstances, is highly improbable, if not impossible.

I have stated these facts for the purpose of showiug the utter groundlessness of the supposition that boilers are exploded by the agency of a gaseous compound; in my opinion such is never the cause, and having no foundation in truth, I am inclined to treat such a theory as purely speculative, unsupported and unprotected by a single fact.

We need not, however, hesitate to assume that the foregoing theory is quite applicable to the case before us, for I think the evidence will go to prove that the boiler at, or shortly before the time of explosion, contained an ample quantity of water; and assuming this to be the case, we shall have less difficulty in accounting for the distressing consequences which followed.

In the progress of the investigation, I thought it desirable to have plans and drawings made of the premises, both before and after the explosion. The boilers which supplied the engine and mill were three in number. Two of them were under the mill, which was six stories; and the other (which was new, and had been at work only a few weeks), was situated close to the other two, but out of the building, between the blowing-room and the gable wall of the mill. From this description, the position of all the three boilers previous to the explosion will be seen, and being all three connected by a common steam pipe, and each having a stop valve, gave the power of working them either collectively or separately, as the case might be. The new boiler was of the cylindrical form, about 30 feet long, and 7 feet 6 inches diameter, and apparently strong and well made. The other two were of the waggon shape, about 20 feet long, and 7 feet 6 inches wide; and from what I could learn, had been at work about ten years.

The boiler A was that which exploded, and had been working, in conjunction with the new boilers, for some time previous to the accident. It was a large boiler of its kind, and being of the worst form for resisting pressure, it would of necessity be the first to give way, and that more particularly under the accumulated internal force which at the time must have been acting upon it.

In calculating the strength of vessels subjected to severe internal strains, operating equally in every direction, it is important, first, to consider the form, and secondly, the disposition and union of the plates, of which the vessel (such as a boiler) is composed.

Now, it is found that the cylindrical boiler, probably with hemispherical ends, is the strongest, and provided care be taken to cross the joints with proper connecting rivets, we may reasonably conclude that this description of boiler is the best to ensure safety under an extreme pressure of steam. But an extreme pressure should never be allowed to take place, nor would it ever occur, provided those intrusted with the management and control of steam-boilers were careful to have proper safety-valves for the discharge of the steam, and to keep them in working order.

Viewing the subject in this light, it will be my duty to direct attention to certain deficiencies in the present system, and to offer suggestions calculated to insure greater protection to the public under circumstances where their lives are at stake.

On a careful inspection of the boilers, it cannot be doubted, that however well adapted the cylindrical boiler was to resist pressure, the old waggon boiler A (which exploded) was miserably deficient. This boiler was not only imperfect in construction as regards form, but the plates of which it was composed were varied in thickness from a quarter to three-eighths of an inch, and the lower plates which formed the seating of the boiler were most of them cracked, and showed evident signs of imperfection as regards the quality of the material. These parts, although weak, were, however, not the first to give way, as, having a good support on the brick-work, the rupture took a different direction, by tearing the plates along the bottom about twelve to fourteen inches from the seating, and the steam, having no outlet at the top, not only burst out the end next to the furnace, demolishing the building in that direction, tearing up the top from the opposite end; it ultimately forced the boiler upwards, and carried the floors, walls, &c. of the building before it. From the state of the ruins, and the position in which the boiler was found, lying across the railway, it must have taken an oblique direction: and, looking at the disastrous consequences which ensued, we need not hesitate to assume that an enormous force was exerted upon a comparatively weak and imperfect vessel. Under ordinary circumstances I should hesitate to give an opinion on a matter of such importance as the present, involving considerations probably affecting the reputation of parties connected with the property, and of others who may have taken upon themselves the responsibility of acting or directing in the affair. But having been professionally called upou to investigate the cause of the late melancholy occurrence, it is my duty, irrespective of such consequences, to state the facts as they came before me, and the impressions they made on my mind, and also to offer for consideration such suggestions as may at least end to the diminution, if not the prevention, of such calamitous events.

On a careful examination of the boiler, I found the construction as well as the material imperfect; but still not so defective as to be the immediate cause of the explosion. I am inclined to think that the safety valves, of which there were two on each boiler, must not have been in a working state at the time. They were each four inches diameter, but the branch pipe from that on the old boiler was only three and a half inches, consequently the area for the discharge of the steam from both boilers was only 22·18 square inches. This area is under one-third the size of a steam-pipe usually employed to carry off the steam as fast as it is generated, at a pressure of about 10lb. to the inch, probably of sufficient capacity to relieve the boilers in case of increased pressure, but not to the extent of meeting all the requirements of intensely heated fires, with no other exit for the steam. There is, however, no evidence to show that the safety valves were discharging steam at the time of the explosion, and, presuming one or both of them to be fast, we are then at no loss to discover the real cause of the accident which shattered the buildings and destroyed so many lives.

In addition to the reasons I have adduced for the causes of explosions in steam-boilers, I may meution another which of late has attained considerable credence amongst men of science, whose opinions are well entitled to respect—that is, the new theory of the spheroidal state of bodies as exhibited in the experiments of Prof. Boutigny, and those of Mr. Bauman, late of Manchester, now of King's College, London.

These experiments show that a drop of water projected upon a hot plate does not touch it; that a repulsive action takes place, and these phenomena are explained on the supposition that the spheroid of water has a perfect reflecting surface, and, consequently, that the heat of the incandescent plate is reflected back upon it. What is most extraordinary in these experiments is the fact that the globule, whilst rolling upon a red hot plate uever exceeds a temperature of 104 degrees of Fahrenheit, and in order to produce ebullition it is necessary to evolve the plate until the water begins to boil and is rapidly dissipated in steam.

Now the theory of this is, that the boiler being nearly dry, might have water injected upon it when red hot, and having cooled down the plates ebullution would ensue, and a rapid, and probably a destructive generation of steam might be the result. This theory will not, however, apply to the case before us; and I must again resort to the first opinion, that the accident originated in having intense fires under the boilers when the engine was standing, and in all probability when the safety valves, from unknown cause, were fast, there being no escape for the elastic vapours, explosion was the result.

Next in importance to ascertaining the cause of the accident comes the consideration how these catastrophes are to be prevented. This is a subject of such deep interest to the community that it has attracted the attention of the leading governments, and the scientific men of Europe aud America. Legislative enactments have been passed recommending remedies and inflicting penalties, but so long as men are careless of their own lives, and ignorant of the consequences to others, there is little or no hope of improvement. In regard to a better and more efficient management of steam boilers, which coutain within themselves, under proper control, the elements of a vast utility, but guided by ignorance and abandoned to the effects of a blazing furnace, they become the agents of a destructive force that cause impressions too painful to contemplate. Familiarity with any sort of danger leads to callousness and neglect of due caution, and it is to be regretted that the general state of education in this country does not directly tend to the improvement of the engineer and his assistants. It is my confirmed opinion (now that the country is covered with steam and steam-engines), that the engineers, stokers, and firemen should be persons of some education. They should at least be conversant with the common rules in arithmetic, and should receive instructions in the more simple laws of physics; and above all, they should be men of sober habits and exemplary moral conduct. In addition to these qualifications they should be made acquainted with the properties of steam and the steam-engine, and should on no account be employed where these are deficient.

In the present state of intelligence amongst that class of men we can scarcely hope for much improvement. It is, however, a subject well worthy attention, and viewing the immense extent of steam-power in operation, both on land and at sea, it is well entitled to the deliberate consideration of the Legislature, and I am not without hopes that Parliament will shortly entertain the subject, and cause the erection of seminaries for the exclusive purpose of protecting the public by the education of engineers.

Each boiler should have a water gauge and two fusible plugs composed of alloys adapted to the certified pressure of steam within the boiler, as recommended by the committee of the Franklin Institute.

These precautions being taken, but above all the employment of steady careful men, we may reasonably look forward to, if not a total prevention of explosions, at least a considerable diminution of those frightful accidents which, if often repeated, will eventually call for legislative interference.

After the selection of competent engineers and assistants I would recommend the following precautions:—

1. That the practice of placing boilers under buildings where the work-people are employed be discontinued.

2. That two safety valves be attached to each boiler; one of them to be weighted from the inside to the required pressure, and to have a long ascending discharge-pipe, out of the reach of interference; the other to be under the control of the engineer. These valves, in order to be perfectly safe, should have respectively an area equal to one-half of the steam-pipe, or about one square inch to every two horse of the computed power of the boiler.

3. That in cases where boilers are situated under mills, a mercurial gauge, indicating the pressure of the steam, and an ascending column of water, corresponding with that pressure, will be found of great value, in cases of negligence on the part of the firemen or engineer.

Lastly. Each boiler should have a water gauge and two fusible fire plugs, composed of suitable materials.

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### BARON DUPIN ON ENGLISH HARBOURS OF REFUGE.

At a late meeting of the French Institute, Baron Dupin read the following paper:—

It is now twenty-eight years since I laid before the Academy an account of great works undertaken by the British Government, with a view of making Plymouth the finest port of defence and refuge for the Royal Navy and merchant vessels. These works, carried on with remarkable activity, although begun thirty years after those of Cherbourg, have long since been completed. At this present moment England is projecting the making of new ports of aggression, or, if you prefer it, of defence and refuge, nearer and nearer to the coast of France. Under more than one point of view these works interest the arts and science; and such is the reason which leads me to communicate them to the Academy. In 1843 a select committee of the House of Commons, appointed to inquire into the accidents to trading vessels off the coast of England, in its report recommended to the Government the establishing of ports of refuge in the British Channel. This committee, acting most judiciously, abstained from pointing out any particular situations for such ports; it on the contrary, gave it as its opinion that the subject would be much better treated by scientific persons having practical knowledge and specially appointed for the purpose. With a view of carrying out this recommendation, Sir Robert Peel, the Prime Minister, first ascertains that the persons the most capable will undertake the inquiry just mentioned. Having taken this first step, Sir Robert Peel obtained from the Lords of the Treasury the appointment of a commission, consisting of Sir Byam Martin, who was for many years Chairman of the Navy Board, and who during the war had been a member of several important commissions of inquiry as chairman; Lieutenant-General Sir Howard Douglas, formerly High Commissioner at the Ionian Islands, and previously Governor of the Military College at Sandhurst, author of several very valuable military works; Rear-Admiral Deans Dundas, an officer of great experience; Sir William Symonds, Surveyor General of the Navy, and successor to the celebrated Sir Robert Seppings; two naval captains, John Washington and Fisher; Colquhoun, a colonel of artillery; Alderson, a colonel of engineers; Sir H. Pelly, deputy-master of the Trinity-house; and Mr. Walker, President of the Institute of Civil Engineers of Great Britain, and worthy of such an honour from the important works of which he has had the superintendence. Here is the formal instruction given by the Lords of the Treasury to this grand commission as to the objects to be forthwith more immediately considered:—

'First. To determine whether it be advisable to have a port of refuge in the British Channel, with a view to the public benefits which such a work shall hold out; and, on the other hand, what would be the cost of executing the works to be recommended.

'Second. To determine the spot which will be best suited for a port of this description, so as to combine, in the highest degree, the three following capacities:—

'1. That it may be entered with ease at any state of the tide by vessels in danger from bad weather.

'2. That the port be such as to be suited to a naval station, in case of war, and may at the same time serve for purposes of defence and attack.

'3. That it may offer ready means of defence in case of attack from an enemy.'

This is not all; should the commissioners not find that all these requisites can be obtained by only one port of refuge in the British Channel, they are authorised to extend their surveys in consequence, and then to report on the advantages peculiar to the different situations they shall deem advisable to recommend, pointing out such as they may consider the most eligible. These remarkable instructions are dated the 2d of April, 1844. These commissioners lost no time in setting about the duties imposed on them. The English coast and ports on the British Channel were surveyed. The commissioners had the assistance of the information possessed by persons of special knowledge. They examined the most experienced pilots, the officers of the Coast Guard, the most celebrated engineers—such as Mr. Brunel, Mr. Rennie, Captains Samuel Brown and Vetch; learned geologists—such as Mr. De La Beche, President of the Board of the Geological Map; Mr. Philipps, President of the Society of Geological Economy, &c. As early as the 7th of August, 1844, the commission had got through its labours, and presented its report to the Lords of the Treasury. Finally, in consequence of an address to the Crown on this subject, the First Lord of the Treasury laid on the table of the House of Commons the commissioners' final report.

I shall, in a succinct analysis, lay before you the chief results of their labours, looking at them with reference to hydrography and nautical arts. At the first view it might be thought that the south-west coast of England, liberally provided by nature, and during a long period seconded by art, offers a sufficient number of ports of refuge, possessing all requisites. We have already mentioned Plymouth, to which must be added Falmouth, the situation the farthest to the westward. Returning eastward we successively find Dartmouth, Southampton, Portsmouth and the Thames. Not only did the commission not find these chief ports of refuge to be sufficient, but it found that the addition of one great port to the preceding would not suffice; it recommends works and an outlay for four new stations, which I shall successively mention. The commissioners made a survey of the whole line of coast between Falmouth and the port of Harwich to the north of the Thames and beyond the limits of the British Channel. They now took soundings for the purpose of ascertaining whether the depth of water at the principal naval stations along this whole line of coast had not varied since the publication of the most recent maritime charts. All this was effected under the skilful direction, at the ports of the eastern part, by Commander Sheringham, and at the ports in the western division under the superintendence of Captain Brown, one of the members of the commission. Besides this, the commission received all the assistance which the Lords of the Admiralty could afford it, and was further assisted by the knowledge possessed by Captain Beaufort, the chief hydrographer of the Royal Navy, and correspondent of the Academy. It availed itself of the opinions of the two great societies of Lloyd's and of the shipowners, as to the selection of naval stations, which may be or become the best as to places of refuge.

A special commission, appointed in 1840 (this is a period worthy of remark), gave the preference for creating new ports of refuge—first to Dover, secondly, to Beachy Head, thirdly, to Foreness, near the North Foreland. The following are the particular instructions to the Commission of 1840:—'To survey the coast from the mouth of the Thames to Selsea Bill; to examine the ports with reference to the shelter they may be capable of affording in case of bad weather to vessels sailing in the British Channel, and as to their being places of refuge for merchant vessels chased by armed vessels in time of war, and more specially as to their becoming stations for armed steamers, in order to protect British trade in the narrow parts of the Channel.

Foreness, nearer than Margate to the extreme point of the southern coast of the Thames, is a fine situation, which was recommended by the commission of 1840, but only as a third place, for a port of refuge: it recommended in preference two other points—first, Dover; second, Beachy Head. Most certainly, Foreness, converted into a port, would often present a very favourable anchorage, whether for trading vessels sailing from the Thames, and which encounter gales of wind when off Foreland: or for vessels returning to England, and which are detained by contrary winds. The new commission observes, that the same advantages may be more fully and conveniently obtained by improving the port of Harwich, on the other side the Thames, as the point of the coast where the North Sea begins. In fact, this port, which will be the natural station for a fleet of war steamers, will afford the best refuge for merchant-vessels; whilst the neighbouring anchorage afforded by the bay of Hollesley will suitably receive ships of war. In consequence, it does not appear that the secondary situation of Foreness is to be selected for making a port of refuge. One is strengthened in coming to this conclusion on looking to the advancement in a commercial point of view of Ramsgate, which is but at a very short distance from Foreness. In 1748 Ramsgate was no more than a small creek—an open bay without importance; it is now a harbour of sufficient extent to receive a considerable amount of shipping.

The following is the increase in numbers of merchant vessels having entered Ramsgate harbour in the following years :—

| Years. | No. of Vessels, |
|---|---|
| 1780 time of war ... ... ... ... ... | 29 |
| 1785 time of peace ... ... ... ... ... | 215 |
| 1790 time of peace ... ... ... ... ... | 387 |
| 1841 time of peace ... ... ... ... ... | 1,543 |
| 1842 time of peace ... ... ... ... ... | 1,652 |

Four years ago the thirty-one largest vessels which entered Ramsgate harbour measured on an average 457 tons—a greater tonnage than that of two-thirds of the British merchant vessels in foreign trade. In 1832 as many as 434 vessels were at the same time iu Ramsgate harbour; if the new basin about to be formed to the westward be added, Ramsgate will then be capable of containing simultaneously 600 vessels.

Sir John Pelly, deputy-master of the Trinity-house, had proposed, as a place for constructing a port of refuge between Ramsgate and the Thames, at the anchorage ground called the Brake. In support of this proposition, he produced plans made by Sir John Rennie, the second son of the celebrated engineer Rennie, of whose works at Plymouth, Sheerness, London, &c., I have given a description. Sir John Rennie proposed to erect on the top of the longitudinal sand-bank, within which is the anchorage called the Brake, a breakwater, or jetty, similar to that at Cherbourg, but only twenty-three inches above the highest water. His plan would lead to an expense of 3,200,000*l.*, including the necessary deepening of the projected anchorage-ground, which would not have been less than five miles in length. If so large an expenditure were objected to, Sir John Rennie would reduce to 1,500 yards the proposed length, in which case the cost would only be 850,000*l.* Finally, Sir J. Rennie, as a middle course between these two extreme plans, proposed a third, which would have led to an expenditure of 1,200,000*l.*

Among the reasons adduced against the adoption of any of these plans, and several others proposed by Captain Vetch and by Sir S. Brown, I must mention the strongest. A uaval officer, employed on the hyrography of the coast, has found that the sand bank called the Brake, had shifted nearer to the land by 700 yards or 640 metres. So soon as the corporation of the Trinity-house became acquainted with this fact, it altered the situation of its buoys from the south and middle on to the Brake saud bank: at the same time publishing, for the information of all seamen and the public in general, an account of this very remarkable change. The commission of 1840 had already rejected the plan of erecting a harbour at the Brake. The commission of 1844 comes to the same conclusion, founded on the grouud, that a port in such a situation could only be of service to vessels having already escaped all the dangers of the narrow part of ihe British Channel, or to vessels leaving the Thames to begin their voyage by a course to the southward. Relying on these reasons, the commissioners reject the very expensive proposition of a harbour at the Brake, and they are strengthened in this resolution by the fact that the Downs in their present state possess an excellent bay. This bay may be said to be coutiguous to Ramsgate harbour, which can already contain 400 vessels at the same time; a port about to be rendered capable of holding 600, if not more. Continuing to advance from the north towards the south, the commissioners arrive at the most important situation—at that which they prefer. It is the situation of Dover, a point at once the nearest and the most threatening for France.

In my works on the naval and military forces of Great Britain,* I have pointed out the great importance of Dover for one and the other of these forces, and the vast works, whether of the port for trade or the fortifications of this town. Since the publication of my first descriptions, Dover has become of greater importance, as being the terminus of the railroad which comes from London to this port, and which branches to sundry other lines. In two hours' time corps of troops, ships' crews, ships' stores and munition, and an entire train of artillery, may be brought down to Dover from London, Deptford, Woolwich, and Portsmouth. Dover has a dry dock suited to the repairing of merchant vessels, a great extent of large quays, and extensive warehouses. Besides its outer basin, the floating basin has an area of more than six acres superficial measure, and works are going on for doubling this extent. There is also a third basin (called the Pent) which might be put into a state for containing a great number of sloops of war and gun-brigs—a basin which is now undergoing considerable improvements.

At the time the celebrated Mr. Pitt was carrying on a mortal struggle between England and France, he strongly wished to form an enclosed roadstead in front of Dover, and he had plans made with that view; the Ordnance department found them in its archives, and communicated them to the commission whose labours I am now noticing. Two kinds of objections have been started against resuming the consideration of these plans. It was contended that the bed of the roadstead has a constant tendency to rise, owing to the deposit of alluvions. 2. That the anchorage ground was bad. In order to test this latter objection, Capt. Washingtou superintended experiments, which have been deemed conclusive, by anchoring in the roadstead a steamer of 500 tons and 120-horse power. After having cast anchor in the most important parts of the roadstead. the whole force of the engines was made to act on a sufficient length of cable run out, without this powerful action having in any way loosened the anchor from its hold. No action of the wind on a vessel without sails could equal a similar impulsion. This experiment must appear conclusive as to the excellence of the anchorage in Dover-roads.

In order to ascertain what is to be apprehended from the deposits by the waters in front of the present port of Dover, samples of the water have been taken at the times of the highest tides, selecting calm weather :—

First Samples of Water, taken July 2, 1844.

| Time and situation of the water being taken. | Depth of the water at the point where taken. | Foreign substauces deposited, per cubic foot. |
|---|---|---|
| | Feet. | Graius, |
| 1.—At low water at the surface of the sea ... ... ... | 42 | 10.21 |
| 2.—At half tide— | | |
| At the surface ... ... | 51 | 13.20 |
| At 9 feet below ... ... | 42 | 6.00 |
| 3.—At high water— | | |
| At the surface ... ... | 60 | 3.43 |
| At 9 feet below ... . | 51 | 7.21 |
| At 18 feet below .. . | 42 | 11.33 |
| 4,—At half ebb tide— | | |
| At the surface ... ... | 31 | 6.38 |
| At 9 feet below ... ... | 42 | 6.92 |
| Foreign bodies in suspensiou per cubic foot of sea water in front of Dover, average quantity . . . | | 8.11 |

Mr. Philipps, the President of the Society of Geological Economy, who was intrusted with making these analyses, contrasts them with the results of those found from the Thames, when there were no rain alluvions, and the waters were limpid.

Quantities of Foreign Bodies in Suspension in the calm and limpid Water of the Thames.

| | |
|---|---|
| At Brentford . ... ... ... | 1.75 |
| At Hammersmith ... ... ... | 1.83 |
| At Chelsea ... ... . ... | 4.15 |
| Average quantity ... ... | 2.58 |

Second Samples of Water outside Dover, on the 17th of July, 1844.

| Time and situation of the water being taken. | Total depth below the point from which the water was taken. | Foreigu bodies suspended iu a cubic foot of water |
|---|---|---|
| | Feet. | Graius. |
| Low water at the surface ... ... | 42 | 10.26 |
| Half flood tide— | | |
| At 9 feet below the surface ... | 42 | 51.29 |
| High water— | | |
| At the surface ... ... ... | 60 | 24.10 |
| At 9 feet below the surface ... | 51 | 22.28 |
| At 18 feet below the surface ... | 42 | 53.76 |
| At half ebb tide— | | |
| At the surface ... ... ... | 51 | 30.93 |

Examination of the Bodies in Suspension.

| | Proportions. |
|---|---|
| Sand ... ... ... ... .. .. | 52 |
| Lime with a small quantity of argile and oxyde of iron | 24 |
| Vegetable substances ... ... ... ... | 24 |
| | 100 |

The commission was not satisfied with these experiments; it asks for fresh ones, for the purpose of ascertaining the quantities of substances kept in suspension by the running of the tide on the Dover coast, and liable to be deposited. The commission asks that these experiments may be continued for a whole year under the directions of the Board of Admiralty. Here are the conclusions of the commissioners in favour of Dover, adopted unanimously, excepting one dissentient vote—that of Sir W. Symonds.

Dover, at four miles and a half from the Goodwin Sands, advantageously situated for affording protection to the navigation of the Straits, is the natural station for ships of war: there can be no doubt of its importance in a military point of view. Further, the construction of a harbour of refuge at this spot is indispensable, in order to give to Dover that efficaciousness as a naval station necessary to the safety of that part of the coast, and to protect commerce.

Following the English coast from Dover to the westward, the first projecting land or cape which presents itself, at a distance of twenty-eight miles, is a remarkable situation, which attracted the attention of the commissioners. The cape of Dungeness is protected by a fort erected near the extremity, behind the lighthouse, and by four batteries at the sides, two to the east and two to the west. This cape presents a singular conformation of shingles spread over a face of several miles, stretching out into the British Channel, and terminated by deep water

* *Travels in Great Britain*, Part I., "Military Strength," 2 vols. 4to: Part II., "Naval Strength," 2 vols. 4to, with an atlas to each part.

close to both its extremities. This bank, in front of Dungeness, has considerably advanced into the sea since the lighthouse was constructed in 1792. At that period, at low water, the sea was at no more than 100 yards from the tower, whereas it now is at 190 yards, which is an increased length of ninety yards in half a century. The commissioners recommend that regular surveys be made in order to ascertain the annual progression of the bed in front of Dungeness lighthouse. The two bays to the east and west of this cape afford an excellent anchorage. More than 300 sail of shipping have ridden at anchor at the same time in the eastern bay, and more than 100 in the western bay, as the winds caused the one or the other to be selected for a place of refuge. The only inconvenience attendant on such a good anchorage is not to have at hand, as at Dover, Seaford, and Portsmouth, the advantage of an inner port. This inconvenience, added to the very short distance from Dover, is the reason which has led the commissioners not to recommend the construction of any considerable works at Dungeness. When nature, rightly say the commissioners, affords such a convenient shelter, it will always be a matter for serious consideration to be satisfied with that which is found to be well, in order to reserve the means of bestowing on other places of admitted importance as to situation the artificial assistance which may give them the capacity of a safe and sheltered anchorage. These reasons have led the commissioners to lay aside any idea of erecting a breakwater for protecting the anchorage to the east of Dungeness.

Starting from the cape of this name, proceeding to the westward, the coast again recedes, and forms something of a bow, at the centre of which is the celebrated situation of Hastings; at the extremity of the bow or semicircle is Beachy Head. To the east of this cape is the Bay of Eastbourne; to the west are in succession Seaford and Newhaven. The Bay of Eastbourne is protected by a series of Martello towers, constructed at the time of the preparations of England against our expedition from Boulogne; they are close to the highest water line, in order to be the more effectual against a landing, very feasible in that direction, as was proved not far from thence by William the Conqueror. In front of Eastbourne the bed of the sea is very irregular; soundings were taken with very particular care; the consequence of which has been to induce the commissioners to abandon the idea of erecting a breakwater, which would cover too confined a space in proportion to the necessary outlay. They turned their attention wholly to the other side of the cape, on Seaford: here there is a magnificent anchorage, whieh fortunately is at an equal distance from Dover and Portsmouth.

Such is the intermediate situation at which the commissioners have not shrunk from recommending to the Government the erection of great works. It recommends in a direction from N.N.E. to S.S.E., a breakwater or jetty, of one nautical mile in length, and having a rectilinear return at each extremity, to be eonstructed—this jetty to be towards the middle in forty-one feet water, and something less at the extremities. Behind this long jetty there would be more than sufficient water for first class vessels; and nearer land there would be an extensive space for merchant-vessels of all sizes. This formidable situation would threaten, at the same time, all the French ports comprised between Havre and Boulogne.

Distanee from the Harbour of Refuge and Aggression at Seaford.

| | Miles. |
|---|---|
| To Boulogne ... ... ... ... .. ... | 52 |
| To the mouths of the Somme ... ... ... | 60 |
| To Dieppe ... ... ... ... ... ... | 60 |
| To Fecamp ... ... ... ... ... ... | 60 |
| To the cape in front of Havre ... ... ... | 72 |

This harbour will, no doubt, experience some inconvenience from not being sufficiently sheltered by Cape Barrow on the N.W., which wind prevails especially in the bad season; but this objection is not of predominating influence with the commissioners. They take into consideration the proximity to the inland port of Newhaven, and do not hesitate to recommend for so important a situation an outlay of 1,200,000*l*. Let us add, that as the crow flies, the distance from Seaford to London is only about seventy-four miles, and that by means of the railroad from London to Brighton, from which a branch may easily be constructed, there will be no difficulty in getting from the capital to Seaford in less than two hours.

Newhaven, of which I have just spoken, is a good port, into which the tide flows. It may, however, be improved; it may hereafter be sheltered by a breakwater, running from Cape Barrow to the point where there are fifteen to sixteen feet water at the equinox neap tides. The jetties which form the mouth of the inland port, may be at the same time extended, this mouth may be widened and deepened. But as this entrance cannot be rendered accessible to shipping at all times of the tide, Newhaven is, therefore, not comprised in the naval stations respecting which the commission can make any recommendation. The British navy will have nothing to wish for from Seaford to Portsmouth; it is necessary to proceed sixty miles to the westward to arrive at the magnificent situation of Portland. Portland island shelters on the west and south the extensive roads of that name, which are open to the east. These roads are contiguous to those of Weymouth, which look to the south. The commission proposes the erection of a jetty which would cover the south-east Portland-roads. This jetty is proposed to be of 2,315 metres, with a passage pretty near land, at a spot where the depth is not less than forty two feet. The cost is estimated at half a million. It may surprise that with such a depth of water, a jetty of this length may be constructed for so small a sum; but at Portland all tends to make the construction of a jetty both cheap and easy. It is to be observed, that Portland contains inexhaustible stone quarries, of which a considerable number belong to the State, and will, therefore, be at hand to supply the stone and lime for the jetty. The island abounds in fresh water springs, which will suffice for supplying the vessels in the roads. Finally, this situation affords the advantages of an iuland port, which is formed by the mouth of the Wey, as the name of this town indicates. Such are the combined works which the commission recommends to be executed at this spot. A naval station at Portland will protect, in conjunction with that at Dartmouth, all the intermediate points. These two stations, along with Plymouth, will complete the chain of communication, co-operation, and protection from Dover to Falmouth, a distance of 300 nautical miles.

Exclusive of this vast line, and in order to extend it northward, and beyond the straits in the Chaunel, new improvements are recommeuded for Harwich-roads. Two rivers, the Stour and the Orwell, fall into each other immediately above the town of Harwich; the continuation of their course forms a crescent round the town before emptying themselves into the sea. For the purpose of narrowing this mouth, and to convert it into an enclosed roadstead, it is proposed to carry out from the land on the side of Harwich a jetty of half a mile in length. Thus one of the finest roadsteads on the coast of Great Britain would be protected—a roadstead having an excellent bed and sufficient depth of water for all class of ships, and capable of containing a vast number of merchant vessels. A fleet intended for the protection of the North Sea, or the Thames, would be most admirably placed at the Harwich station. Let us add, that these are the only safe roads on the eastern coast of England. They are in the direct line of the trade of the Thames with the northern ports of Great Britain and the north of Europe. Harwich already has building yards which belong to the State; the Ordnance Department also has land and has establishments at this place. I pass over the particulars of the damage done to the anchorage at Harwich in the last twenty-five years by injudicious excavations at the cape which sheltered the entrance from the west—a damage which the proposed works would remedy. The channel leading to the anchorage would be excavated to a depth of 18 feet below the lowest watermark. I now give a summary of recommendations, of which I have faithfully stated the grounds. First of all, it is recommended to construct at Dover a harbour of refuge entirely enclosed by jetties, with two entrances, one to the east 150 feet, the other to the south 700 feet wide. This harbour to measure 520 acres, of which 370 are to have a depth of 12 feet at the least. 'Deeply convinced,' say the commissioners, 'that it is indispensable to obtain without delay a sheltered anchorage in the bay of Dover, we venture earnestly to call the attention of the Lords of the Treasnry to an immediate commeucement of the works, by first constructing the jetty running out from the west of the entrance to the port of Dover. This first jetty, which shelters the bay on the west, will insure smooth water in the bay when the winds blow from that quarter; it will stop the alluvions which progress from the east; it will facilitate the execution of the other works, whatever may be the final plan. Whilst this jetty is in course of construction to the west, the experiments recommended as to the bodies in suspension in the waters of the bay, and the shifting of the alluvions, will be completed. These experiments will allow of adopting definitively the best plan for the exterior harbour, and the most suitable dimensions of the entrances.'

The breakwater or jetty recommended for Seaford is to shelter an anchorage of 300 acres. The breakwater at Portland is to shelter an anchorage of 480 acres. As to the succession: it is not possible to undertake at the same time the construction of three breakwaters; the commission proposes—first, Dover; second, Portland; and last, Seaford. As to the expense, the commission does not hesitate to recommend the following outlay:—

| | £. |
|---|---|
| For Dover . . . . . | 2,500,000 |
| Seaford . . . . . | 1,250,000 |
| Portland . . . . . | 500,000 |
| Total . . . | 4,250,000 |

So far from being surprised at the amount of this expenditure, it will probably be found to be below the reality when the following simple fact is considered. If it be supposed that the above-mentioned breakwaters or jetties be placed continuously one after the other, the total length will be equal to three times that of our long jetty at Cherbourg! As to the means of constructing, the commissioners availing themselves of the experience acquired by the French for the jetties at Cherbourg and Algiers, state that they will give the preference to stone masonry over pitched iu stone. As to the protection of the ports of refuge by land defensive works, Dover and Seaford are already provided with the requisite ones. Portland Roads are commauded in the most advantageous manner by the island of Portland, on which it will be easy to erect such fortifications and batteries as may be required for defence.

After having made a report of their labours, and given the reasons for the conclusions they had come to, the commissioners wind up definitively in the following manner:—

'The commission cannot close its report without expressing, in the strongest terms, its unanimous opinion, and its thorough conviction, that it is indispensable to adopt such measures as may afford the south-east coast of the kingdom a powerful naval protection. Without any exception the ports into which the tide flows, situated on the coast between Portsmouth and the Thames are incapable of receiving large steam-ships. Consequently, now that steam produces such great alterations in the situation of naval matters, there is an imperative necessity for supplying, by artificial means, the want of suitable ports in the narrow parts of the British Channel. An hydrographical chart will show the situations where, according to our recommeudations, ports, enclosed anchorages, well sheltered, will afford a refuge to our merchant shipping. By these means, added to the use of steam at sea, with railroads and telegraphic communications on land, the naval and military force of Great Britain may in a few hours be rendered most efficient on all points of the coast. The recommendatious which we have deemed it our duty to submit to your Lordships to be carried out, require a heavy outlay of public money; but when the lives, the property of citizens, and national security are at stake, we do not believe that considerations of money are to be an impediment in the way of realising results of such vast importance.'

The general chart referred to by the commissioners in their recommendations, shows a series of distances which must strike every attentive observer. I now give them in their order, proceeding from west to east:—

| | Miles |
|---|---|
| From Falmouth to Plymonth, first centre of protection and aggression ... ... ... ... ... ... | 38 |
| From Plymouth to Guernsey, at the entrance of the Gulf of St. Malo ... ... ... ... ... ... | 78 |
| From Plymouth to Dartmouth ... ... ... ... | 30 |
| From Dartmouth to Portland (second important centre of protection and aggression ... ... ... ... ... | 45 |
| From Portland to the Anglo-Norman islaud of Guernsey ... | 60 |
| From Portland to Alderney, second Auglo-Norman island (Alderney is 20 miles from Cherbourg) ... ... ... | 48 |
| From Portland to Portsmouth, passing off the Isle of Wight ... | 60 |
| From Portsmouth, third centre of protection and aggression, to Alderney ... ... ... ... ... ... | 87 |
| From Portsmouth to Seaford, fourth centre of protectiou and aggression ... ... ... ... ... ... | 58 |
| From Seaford, doubling Beachy Head, as far as Dover, fifth centre of protection and aggression ... ... ... ... | |
| From Dover into the Thames, as far as the Nore, opposite the naval arsenal at Sheerness, sixth centre of protection and aggressiou | 50 |
| From Dover to Harwich beyond the Thames, seventh centre of protection and aggression — ... ... ... | 55 |

It will certainly be observed that the centres of protection and aggression increase, and I shall say are almost one on the other, as the coast of England becomes gradually nearer to France. From Portsmouth to Harwich, within an extent of only 164 miles, it is recommended to construct iu the sea works which, by estimation of first projects, are to cost £3,850,000 sterling. There are to be five grand centres of protection, capable of receiving five fleets, and serving as starting points of five expeditions, cousisting of large war steamers—expeditions, the furthest off of which may in seven hours reach the coast of France, and the nearest in one hour and a half. This combination of works will have its influence, not to say control over 150 leagues of our coast, from Dunkirk to the Bay of St. Malo.

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## Art. XIV.—LETTERS TO THE CLUB.

Liverpool.—*New Docks.*—The Dock Committee propose to apply to Parliament for power to construct several new Docks in the neighbourhood of the Custom-house. One of these Docks will run parellel to the King's Dock, and will be 730 feet. Salthouse Dock will be carried towards Mersey-street, with a width of 380 feet, and a leugth of 729. All Nova Scotia is proposed to be bought up, and a large Dock constructed embracing the Manchester basin.

*Bridge over the Mersey.*—The project has often been broached of connectiug the Lancashire and Cheshire shores by a bridge or tunnel, but it appears probable that it will be left to the railway to accomplish this feat. It is now proposed to throw a bridge over the Mersey at Runcorn. There are to be five wet arches of 280 ft. span, 100 ft. above high-water mark at spring tides, and 168 dry arches of 30 feet span,—making a total of 2480 yards of arching, which will be, when completed, the greatest work of the kind in Europe. The rapid rise of Birkenhead into importance, is an additional reason for the accomplishment of this work to those previously subsisting.

*Seven Persons killed by the bursting of a Tank.*—A lamentable accident has occurred at the Harriugton water-works, whereby seven persons have lost their lives and a uumber more have been seriously injured. A water tank belonging to the Harrington water-works, capable of holding 250,000 gallons, which had just been completed by Messrs. Rigby, of Hawarden, burst and carried away two houses and damaged a number more, causing the loss of life I have mentianed.

*Iron Ship Building.*—This branch of trade is very brisk here just now and I think the prevailing impression is, that iron will shortly supersede timber for ship-building purposes altogether. Several iron steam vessels fitted with auxiliary power are now in preparation for the Atlantic, and as you are already aware vessels of a similar description are intended to be put on between this place aud Constantinople. I do not apprehend that the plan of auxiliary power will be found to answer well for Atlantic navigation, as there you have always the wind, which is a stiff steady breeze, either for or against you: in the one case the auxiliary power is needless, in the other insufficient to drive the vessel head to wind. It may be however, that an auxiliary power will enable a vessel to sail closer to the wiud. Several hundred boiler-makers might now find employment here, in addition to those already employed, so great is the demand for iron ships.

*Operative Tailors.*—A paper which has been put forth by the Operative Tailors' Association, shows that 1,187 men, 333 women, and 41 boys are employed in their own houses, which are for the most part in a dirty and unhealthy state; while only 903 men and 139 boys are employed in workshops on their masters' premises. Of the dwellings used as workshops 522 are bed-rooms, and 127 cellars; while in 222 courts parties are working at home for shops. The publication of such facts must lead to amelioration. And I wish the other correspondents of the *Artizan* would collect all the statistics in their power bearing upon the condition of labour, as no good is to be done without a ceaseless agitation.

*Ship Railway.*—A project is on foot for the connection of Manchester with Liverpool by a "ship railway," which is a railway on which vessels might be transported, so as to obviate the necessity of discharging their cargoes at Liverpool. That such a railway might be constructed canuot be doubted, for it would be nothing more than a prolonged patent slip; but I cannot imagine the projectors to have computed the cost of such an undertaking, with the firm foundations, and Cyclopean bridges and embankments it would require; and, after all, I am at a loss to see in what way the scheme would be beneficial. There is very little chance, I imagine, that the project will be carried into effect. I am, &c. J. C.

Manchester.—*State of Trade.*—The engrossing subject here is the League meeting which has just taken place, and at which 60,000*l.* was subscribed to further the cause of Free Trade. We have had a meeting here to consider what working men should do in this crisis, but without having been able to arrive at any conclusive result. The most intelligent of the working men certainly think the creed of the League to be the right one, and there are not now to be found any out-and-out defenders of monopoly, but it appears to many of us that uuless the working classes interpose, the whole of the other classes will be ridden down by the manufacturers. We do not see that the working classes would be benefited by such an event, for we should only be chauging one aristocracy for another, with which the working classes stand in a more direct antagonism. We all know what the masters would do if they could; we know how they would grind down the working classes if they had them beneath their feet, and we have resolved not to trust them "though their skins were stuffed with straw." Unless the power of the working classes can be brought to act against the Free Traders, they will rule this country as they please: the aristocracy are already overthrown, and there is no other barrier except the power of the working classes which can resist the torrent. We look to the association aud the club for counsel in this emergency.

*Building Progress.*—The proposal to erect a new exchange is still agitated, and it appears probable that Mosely-street will be the site adopted. The use of iron is greatly extending; its most novel application is in the Iudepeudent Chapel erecting in Salford, uear the Broughton-bridge, from the designs of Mr. Richard Lano. The structures erected in Terra Cotta have not been so satisfactory as was expected: the material twists in the process of burning, making irregularities in the work, which will not bear a close inspection. Of the School of Design exhibition I have no time to say anything this month, but hope against your next number to be prepared with some remarks on the subject.

*Explosions of Steam Boilers.*—I send you some particulars respecting the explosion at Bolton of which you may make auy use you please. Another boiler explosion has occurred at Willenhall, near Birmingham, by which one man has been killed aud sixteeu or seventeen injured. The boiler was a new one, set to a new engine, just erected to drain a mine: the cause of the accident is supposed to be attributable to the faulty action of the safety-valve.

I am yours, &c., T. W. W.

New York.—The most engrossiug subject here is the President's message, of which you will probably have learned the purport before this reaches you. Steam and the electric telegraph are fast changing the face of the world; the acquisitiou of such distant tracts as Oregon would hardly have been coveted but for the facility of communication these inventious render; and they must therefore be regarded as the tie without which this great republic would fall asunder. The electric telegraph has lately been carried across the river in a tube which was let down to the bottom of the river from a steam-boat. It is proposed to connect all the Atlantic cities of the States with New York by the electric telegraph: by means of a similar connexion with Washington, some of the papers have been boasting that they will be able to report the speeches in Congre s some few minutes *before* they have been delivered. There is some difference in the latitude of the places on the Hudson

*Steam Navigation on the Hudson.*—The Hendrick Hudson, steamer, performed the distance, recently, from New York to Albany, 160 miles, in 7 hours 40 minutes. She ran part of the distance at the rate of 24 miles an hour! The average speed of the Oregon, the new boat built at New York, is 23 miles an hour! and that, it is intended, shall be eclipsed by the Iron Witch, now nearly ready to commence her trips between New York and Albany. The vessels on the Hudson are probably the fastest in the world, a distinction they owe partly to their size, and partly to the high pressure of the steam, and great speed of the piston, or in other words, the large actual power of the engine.

*Produce of Mines.*—The mines in Duchess and Columbia counties, United States, produce annually 20,000 tons of ore; Essex co. 15,000 tons; Clinton 3,000; Frankliu 6,000; St. Lawrence 2,000; amounting in value to more thau 500,000 dollars. The value of iron produced in the United States in 1835 was 5,000,000 dollars, in 1837, 7,700,000 dollars. In Ohio 1,200 square miles are underlaid with iron. A region explored in 1838 would furnish iron sixty-one miles long, and six miles wide; a square mile would yield 3,000,000 tons of pig iron, so that this district would contain 1,080,000,000 tons. By taking from this region 400,000 anuually (a larger quantity than England produced previous to 1829), it would last 2,700 years. The states of Kentucky, Tennesse, Indiana, Illinois, Maryland, and Virginia, possess inexhaustible quantities of iron ore. In Tennesse 100,000 tons are annually manufactured.

J. B. C.

PARIS.—*Belligerent uses of Floating Breakwaters.*—A correspondent of the *Reforme* asks as follows:—'Are your contemporaries aware, that the innumerable floating breakwaters ordered, some of them actually in progress, and others contemplated for every port from Dunkirk to Bayonne, and from Perpignan to Toulon, have, in a military sense, defensive and offensive operations in view, iu addition to the ordinary purposes of such constructions? At this moment, at La Ciotat, between Toulon and Marseilles, a company formed for the purpose are making the experiment. For Havre forty-eight sections are ordered. In fact, the whole of the Chanuel coast, including Treport, is to be immediately fortified in this way; for, I repeat, those breakwaters must be so regarded being positively intended to serve for defence against other encroachments than those effected through the agency of wind and tide. I am assured, that, under cover of floating breakwaters, a steam or other squadron could lie in safety, ready to start at a moment's notice.' This appears to me highly probable, and is well worthy of the attention of the naval readers of the *Artizan*, to whom I commend the question.

*Paris.*—I trust that you will embalm Baron Dupin's observations upon Harbours of Refuge in your pages. You will remark that the leading idea of Frenchmen, in speaking of any of these works, is a belligerent one, and Baron Dupin only incidentally mentions the chief uses of the projected harbours. He continually speaks of them as centres of defence and aggression, as if the commercial were only made a cover for the military objects. Undoubtedly the possession of posts answerable to the purposes of warfare is not to be altogether disregarded, and it is but a commendable prudence with such fickle neighbours as the French alongside, that England should give some attention to her national defences. Nevertheless, I am sure that an Englishman looks upon the most of the money spent upon mere military works as an unwise and profitless expenditure, and the commercial value of all great undertakings is the first that he considers. It is hard to see in what way the formatiou of these new harbours of refuge can furnish additional means of aggression. Portsmouth and Devonport are sufficient for naval purposes, and fleets will only be collected in ports in which arsenals exist. The railways will contribute much more effectually to the defence of the coasts of England, than the formation of any number of harbours; for by their instrumentality, an overwhelming force may be concentrated in an incouceivably short time in any particular point.

*Improvement of the Steam Navy.*—The improvement of the steam navy is an object here of the most sedulous attention, and the Government seems to be animated by more liberal and enlightened views thau those which prevail in England. The Minister of Marine, in a report to the king observes:—'By the side of the old fleet a uew fleet has placed itself, as important as the first, which is destined to accomplish objects and possess resources of a peculiar description, and tends to assume every year an additional development—I mean steam navigation. The formation of this second naval force, which undergoes daily fresh modifications, in consequence of the progress of machinery, gives rise to questions of the highest interest, and a multitude of projects which, although often impracticable, require nevertheless to be seriously examined. Under those circumstances, it appeared to me that by carefully maintaining the Council of Maritime Labours, the utility of which has been tested by experience, it would be expedient to give it additional force, and render its operations more active, by increasing the number of its members.' The king has sanctioned the increase recommended. I think it not improbable that the best of the English naval engineers will one day be enticed into the French Navy.

*Reduction of the Duties on Iron.*—The proposed reduction of the duties on iron intended for railways and shipbuilding has stirred up the advocates of protection to oppose the measure. France, they contend, is too ready to fall into a blind imitation of England, and because the English, who have no forests, are compelled to build iron ships, France, it is imagined, though rich in forests, stands in want of the same commodity.

CALCUTTA.—*Indian Railways.*—Mr. Simms, the engineer, sent here by the Company, has commenced his surveys, which by the end of the cold season will probably be sufficiently advanced to enable him to settle the course of the line. There is high expectation raised here by the introduction of the railway system which, whether the projected lines pay or not, will, it is believed, be most beneficial to the country, both politically and commercially.

*Launch of a Steamer.*—A steamer has been launched from Messrs. Reeves' yard, which is considered to be a fine model. The production of such a vessel iu this quarter is looked upon as no slight matter.

*Colleges and Schools.*—A college is to be founded at Kishnagar, under the sanction of the government, to which youths of all religions will be admitted. Zillah schools have been widely established. It is proposed to establish a college in England for the education of Anglo-Indian children.

MAC.

*Railway Collisions.*—There is no doubt in my miud but that railway collisions are frequently produced by the engineer being unable to face the wind. Sleet and rain are perhaps driving in his face, and how can he keep a look-out under circumstances so unpropitious? One antidote therefore I would propose to the perpetual danger of collision, would be to build a glass-house arouud the engineer. This could be done without difficulty and at a small expense, and I am confident it would render collisions much less frequent. I am, &c., T., *Chancery Lane.*

A BUDGET OF RECEIPTS.—I am gratified to find by the announcement in your last number that you intend to admit letters from correspondents into the pages of the *Artizan.* Those letters, if judiciously selected, and never suffered to become the vehicle of angry contention between obscure and ignorant persons, will be a great additional attraction; aud I doubt not that many able men will avail themselves of your pages, to communicate their thoughts to the public. For some years past I have been in the habit of collecting all the useful receipts connected with the arts that have fallen under my observation—and I propose, with your permission, to send such of these receipts for insertion in the *Artizan*, as may be considered to have the greatest attractions for your readers. There are very few of these receipts which are of my own formation, so that what I may send can have but small claims to originality, and in most of the cases I have preserved no memorandum of the book or person from whom the receipt was obtained, so that I am unable to refer each to its original author. Nevertheless, the collection is, I conceive, entitled to some confidence, as it has been carefully formed and from trustworthy sources. I trust that others of your readers who may have receipts collected, will also communicate them, as the pages of the *Artizan* is a safer depository than mauuscript volumes, and all will be enriched, and none impoverished, by casting their mites into a joint fund, of which each becomes the master.

*Artificial Gold.*—Imitation gold, which not only resembles gold in colour, but also in specific gravity and ductility, consists of 16 parts of platinum, 7 parts of copper, and 1 of zinc, put in a crucible, covered with charcoal powder, and melted into a mass.

*Mosaic Gold.*—Take 4 ounces of tin, $2\frac{1}{2}$ ounces of sulphur, and 2 ounces each of muriate of ammonia and quicksilver; melt the tin by itself, and add to it the quicksilver; when this amalgam is cold, reduce it to powder, and mix it with the sulphur aud sal ammoniac; subject the whole in a covered crucible to a gentle heat, till the white fumes begin to abate, then increase the heat till the crucible becomes just red hot, and keep it at that temperature for about an hour; the aurum musivum, or mosaic gold, which is a compound of sulphuret tin, with a portion of oxide of tin, is found lining the sides and top of the crucible.

*To gild Iron or Steel.*—Make a neutral solution of gold in nitro-muriatic acid (aqua regia) and pour into it a quantity of sulphuric ether; the ether will take up the gold and float upon the denser acid. The article is then to be washed with this auriferous ether (with a hair pencil;) the ether flies off, and the gold adheres.

*To silver Clock Faces.*—Take 1 part chloride of silver, (the white precipitate which falls when a solution of common salt is poured into a solution of nitrate of silver or lunar caustic,) 3 parts of pearlash, 1 of whiting, and $1\frac{1}{2}$ of common salt, or 1 part chloride of silver and 10 parts of cream of tartar, and rub the brass with a moistened piece of cork, is dipped in the powder.

*Pewter.*—French pewter by law consists of $83\frac{1}{2}$ of tin and $16\frac{1}{2}$ of lead, with a tolerance of error of $1\frac{1}{2}$ of lead per cent., that is, it may contain 18 per cent. of lead, but not more. English ley pewter contains often as much as 20 per cent. of lead. The best plate pewter is composed of 100 tin, 8 antimony, 2 bismuth, and 2 copper. Queen's metal consists of 9 tin, 1 antimony, 1 bismuth, and 1 lead; and Britannia metal is a compound of brass, tin, antimony, and bismuth, in nearly equal proportions.

*Brazing Solders.*—Brazing solders may be stated in the order of their hardness—3 parts copper and 1 part zinc (very hard); 8 parts brass and 1 part zinc (hard); 6 parts of brass, 1 part tin, aud 1 part zinc (soft). A very common solder for iron, copper, and brass consists of nearly equal parts of copper and zinc.

*Muntz's Metal.*—This metal consists of 40 parts of zinc and 60 of copper. Any proportions between the extremes of 50 zinc, and 50 copper, and 37 zinc, and 63 copper, will roll and work at the red heat, but 40 zinc to 60 copper are the proportions preferred.

*Pinchbeck* consists of from 3 to 4 oz. of zinc to the pound of copper.

*Soft Gun Metal* consists of 1 oz. of tin to the pound of copper.

*Hard bearings for Machinery* are composed of a metal consisting of 2 oz. of tin to the pound of copper: very hard bearings consist of 2½ oz. of tin to the pound of copper.

*Bell Metal for Musical Bells* consists of 3 oz. of tin to the pound of copper.

*Metal of Chinese Gongs and Cymbals* consists of 3½ oz. of tin to the pound of copper.

*Bell Metal for House Bells* consists of 4 oz. of tin to the pound of copper.

*Bell Metal for large Bells* consists of 4½ oz. to 5 oz. of tin to the pound of copper.

*Speculum Metal* consists of from 7½ oz. to 8½ oz. of tin to the pound of copper.

*Tough Brass for Engine-work.*—1½ lb. tin, 1½ lb. zinc, aud 10 lbs. copper.

*Brass for Heavy Bearings.*---2½ oz. tin, ½ oz. zinc, and 1 lb. copper.

I believe this will suffice at present on the subject of alloys; I shall now give a few receipts, which I hope will be acceptable to those of your readers who are engaged in building.

*Cement for Floors.*---Take two thirds of lime and one of coal-ashes well sifted, with a small quantity of loam clay; mix the whole together, and temper it well with water, making it up iuto a heap; let it lie a week or ten days, and then temper it over again. After this heap it up for three or four days, and repeat the tempering till it becomes smooth, yielding, tough, and gluey. The ground being then levelled, lay the floor therewith about 2½ or 3 inches thick, making it smooth with a trowel; the hotter the season is the better; and when it is thoroughly dried it will make the best floor for houses, especially malt-houses. If any one would have their floors look better, let them take lime of rag-stones, well-tempered with whites of eggs, covering the floor about half-an-inch thick with it, before the under flooring is too dry. If this be well done, and thoroughly dried, it will look, when rubbed with a little oil, as transparent as metal or glass.

*Cement for Joining Stone.*---Take twenty parts of clean river sand, two of litharge, and one of quicklime, and make into a thin putty with linseed oil. When this cement is applied to mend broken pieces of stone, as steps of stairs, it acquires after some time a stony hardness. A similar composition has been applied to coat over brick walls, under the name of mastic.

*Mortar.*---The mortar with which the greater number of the structures raised in Great Britain have been built, consists of one part of lime to three parts of sand.

*Grout.*---Grout or liquid mortar is generally made with one part of lime to four parts of sand.

*Concrete.*---Consists of a mixture of gravel and sand with lime, in the proportions of from four up to nine of the gravel and sand to one of stone lime, that will set under water. The materials are mixed dry, then incorporated with water to a tolerable consistence, and thown into the place where the concrete is to be deposited from a height, so as to give solidity to the work.

*Metallic Sand Cement.*—This cement, which has lately come into considerable use, is composed of blue lias lime and pulverised copper slay.

*A Cement equal to Terras or Puzzolana.*—Take a bushel of sifted iron scales from the anvil, a bushel of argillaceous lime, and a bushel of sand. Incorporate them well and mix with water.

*Plasterers' Stuff.*—*Fine stuff* consists of pure lime saturated with water, and in some cases a little hair is introduced to bind the work. *Gauge stuff* is composed of fine stuff and plaster of Paris, in the proportion of about one-fifth of plaster of Paris to four-fifths of fine stuff. If the work be wanted to dry very quickly, the quantity of plaster of Paris must be increased.

*Hamelin's Cement.*—To any given weight of sand, or pulverised earthenware, add two-thirds of such given weight of Portland, Bath, or any other similar stone, pulverised. To every five hundred and sixty pounds weight of these earths, so prepared, and forty pounds weight of litharge, and, with the last-mentioned given weights, combine two pounds weight of pulverised glass or flint-stone. Then join to this mixture one pound weight of minium and two pounds weight of gray oxide of lead. This composition being thus mixed, pass the same through a wire sieve, or dressing machine, of such a fineness as may be requisite for the purpose intended, preferring a fine sieve, when the composition is to be used for works that require a fine smooth or even surface. It is now a fine and dry powder, and may be kept open in bulk or in casks for any length of time, without deterioration. When this composition is intended to be made into cement, it is spread upon a board or platform, or mixed in a trough; and to every six hundred and five pounds weight of the composition are added five gallons of vegetable oil, as linseed oil, walnut oil, or pink oil. The composition is then mixed in a similar way to mortar, and is afterwards subjected to a gentle pressure by treading upon it: and this operation is continued until it acquires the appearance of moistened sand. The cement should be used the same day the oil is added, otherwise it will fix or set into a solid mass.

*Sugar from Spoiled Potatoes.*—Numerous receipts have been given for extracting the starch from spoiled potatoes, and in Ireland this is at the present time extensively done. From this starch sugar may be made by the following process:—Take of starch, 100 parts; water, 400; animal charcoal, 7; oil of vitriol, 6; chalk, 10. Dissolve the starch in two-thirds the water, and add the vitriol, diluted with the remainder; boil for five or six hours, then add the charcoal and chalk; boil for thirty minutes more; strain, evaporate, and crystallise.

A Farmer.

*How to Stain Marble.*—*Black*, solution of nitrate of silver. *Purple*, solution of nitrate of gold. *Green*, a solution of verdigris in boiling wax, and applied hot. *Red*, solution of dragon's blood; also, tincture of cochiueal. *Yellow*, orpiment dissolved in ammonia. By these substances marble may be stained, and varigatious produced exceeding in beauty those of any natural marble.

*How to make Milk of Wax.*—Melt white wax in a porcelain capsule, and add to it, while in fusion, an equal quantity of spirit of wine, of sp. gr. 0·830; stir the mixture, aud pour it upon a slab. Grind the granular mass with a muller, with the addition, from time to time, of a little alcohol; and as soon as it appears to be smooth and homogeneous, water is to be introduced in small quantities successively, to the amount of four times the weight of the wax: the emulsion is to be strained.

I will not swell this letter by more receipts, as I am not sure that you will give it insertion. Should, however, you decide upon doing so, I shall be happy to send you receipts to about the extent of half a page of the *Artizan* every mouth, and am, yours, &c. Gatherer, *Birmingham.*

*Newcastle as an Iron Ship-building Port.*—In a recent number I read a very interesting account of a meeting in Liverpool, to witness the commencement of a large iron vessel to have the screw propeller and auxilliary steam power. In the article referred to however, I beg to correct what I consider a mistaken piece of commendation respecting the great superiority of Liverpool as an iron shiip-building port. Your words when mentioning the extensive plant of Messrs. James Hodgson & Co., are as follows. "Nor are we surprised at Messrs Hodgson & Co. laying themselves out on so extensive a scale for the building of iron ships, when we consider the great advantages possessed by Liverpool over all other ports, not ouly in great Britain, but in the world in this respect. First, iron is cheaper than at any other port in the universe. Timber of the kind used in iron ship-building is cheaper than in any port in Europe. Coal is, *or will be*, as cheaply supplied, and labour of all kinds is to be readily obtained." Now, although satisfied that Liverpool is well adapted for the construction of iron vessels, yet there are ports on the east coast that have much greater advantages. I allude to Newcastle on Tyne and Sunderland, whore there are extensive iron works for the manufacture of that material, from the smelting of the ore to its finish in the rolls; by which means carriage and delay are avoided, and materials can be got exactly to suit the situations so as to save wast in fitting; the coals necessary for such work it is needless to state are in these districts cheaper by one hundred per cent than in Liverpool, and labour from ten to fifteen per cent lower. Your correspoudent (for such I presume to be the writer of the article referred to) must have been ignorant of these facts or he would not have made such assertions, but this only on a par with the opinion of most Liverpool men, of the superiority of that port in other respects. On a recent visit to Liverpool I was amused to hear a merchant and ship-ownea assert, that there were more vessels, and a greater amount of tonnagr belonging to Liverpool than Newcastle and Sunderland combined, whereas the fact is, Newcastle alone has more ships and greater tonnage than Liverpool; this impression is doubtless made from the circumstance of Newcastle being only ranked as a second class port, and therefore but little noticed in commercial lists. It s to be hoped however, that a port which sends more vessels to sea than any other in the known world, and whose custom receipts are greater than some of the first class ports, will have justice awarded and be speedily placed in its proper position. I have troubled you with these remarks for the express purpose of shewing, through the medium of your valuable journal to those interested in iron ships, that there are other ports besides Liverpool where this important branch of manufacture is cheaply attended to, and as a proof that its advantages are made available, and some attention is paid to the subject on the Tyne, I may mention that in one establishment they have, at the present time, fourteen vessels in course of construction, and in another, three or four large vessels which are intended to have auxiliary steam power. J. C.

*Engineers of first class Steam Vessels.*—Your representations respecting the anomalous position occupied by naval engineers can hardly fail to lead to some change, and the sooner the change comes the better it will be for all parties. The *Times*, a few days ago confirmed your view of the snbject by the following remarks:—"The Retribution, a steam-frigate of 800 horse power, has had seven engineers, five engineer apprentices, and thirty-six stokers, making in all forty-eight persons, employed in working the engines. The importance of having intelligent and able engineers to manage vessels of the magnitude of the Retribution and Terrible, renders it desirable that the first-engineers of frigates of that class should be made commissioned officers, to place them in more direct communication with their captains or commanders than at present; the rank of the first engineer now being a warrant-officer, under the gunner, boatswain, and carpenter. The appointment of first-engineers to commissions in first-class steam frigates, would elevate that branch of the service and induce scientific persons to remain in the Royal Navy, notwithstanding the exertions of foreign Powers and States to induce them to leave Her Majesty's service, by holding out promises of greater advantages and rank in their employment." These you will observe are precisely your views, and unless the Admiralty attends to them speedily, damage will be done. Engineers are in great request at present, and will probably before long come into still greater demand. Is it likely, then, that men of ability will continue in the Navy when they can get better pay and better treatment elsewhere? Or is it to be supposed that men of ability are not needed for managing engines which require four dozen attendants? One consideration ought to weigh much with engineers of steam vessels, in estimating the merits of their position, and it would disincline me to remain in a steam vessel except on most advantageous terms. In a steam vessel a person is out of the way of improvement and promotion, and is liable to fall into lazy habits, which incapacitates him for higher employments. A year or two may be well enough, but I would never advise any engineer of talent, or promise, to set himself down content in a steam vessel, to pass his life in a dull routine. Taking all the circumstances into account, steam vessels are not to be coveted hy able men, except, perhaps, for a year or two, and then the pay and rank ought to be such as to reconcile one to other disadvantages. AN ENGINEER.

*Resistance of the Air in Railway Locomotion.*—It appears very clear from the experiments enumerated in Mr. Stephenson's report, and also from the results of the trial on the Croydon railway, that the resistance to the passage of railway trains, is as great as was stated eight years ago, by Dr. Lardner, bnt at that time generally discredited. I do not understand, however, if the resistance of the air be so great, how the engineer, or the guards of the train can withstand the pressure exerted against them, unless on the supposition that the whole column of air surrounding the train moves with it? A gentle wind travels 4½ miles per hour, and presses 1 oz. on the square foot; a brisk gale 16 miles, and presses 1 lb. 2 oz.; a high wind 36 miles, and presses 5 lbs. 4 oz.; a storm 62 miles, and presses 15 lbs. 7 oz.; a hurricane, 88 miles, and presses 31 lbs. 4 oz.; a great hurricane, 120 miles, and presses 58 lbs. Taking the speed of 60 miles, which has been reached, and, indeed, exceeded on the Croydon railway, we have a pressure of 15 lbs. on each square foot of the engineer or guard's body, which appears to be nearly enough to blow him off the carriage; yet, we are told that at these high speeds no material inconvenience is experienced. It will probably be necessary to make every train consist of an articulated carriage, formed like a ship, and with as few breaks or projections as possible to hold the wind, for high speeds. High speeds, it is plain, will be insisted on, and those railways which do not maintain them, will be deserted.

J. BROWN, *Walworth.*

## ART. XV.—THINGS OF THE DAY.

### FINE ARTS.

*Royal Academy distribution of Prizes.*—Sixteen gold and silver medals have been distributed publicly during the present month, to the competing students of the Royal Academy. An address by Sir Martin Shee, was read by Mr. Jones, the keeper, who filled the chair on the occasion. It related chiefly to the importance which ought to be attached to the choice of subjects in painting, and the president regretted that the choice of subject was so little in the artists' hands. Some remarks next followed on the general subject of composition, which the president arranged under the heads of poetical, classical, and historical, and his remarks were illustrated by references to the best works of the best artists. The introduction of discordant objects into pictorial compositions was strongly condemned, which though sanctioned by some examples of eminent painters was a vice which ought not to be imitated, and the address concluded with certain sanguine anticipations of the beneficial effects to art that might be anticipated from the decoration of the houses of parliament. The students purpose to hold a monthly *conversazione* and are about to form a musenm of costume.

*Monument to the late Dr. Alison.*—An elegant *Mezzo relievo* has lately been placed in St. Paul's Chapel, Edinburgh, to the memory of Dr. Alison, author of the well known "Essay on Taste." This work of art is from the chisel of Mr. Steil, and it is said to be worthy of the distinguished name it commemorates. On a medallion a profile is given which is said to be an excellent likeness. Dr. Alison was the minister of the Episcopal Chapel of St. Paul's, and is remembered by its congregation, as an amiable and learned divine, but his Essay on Taste, has won for him a high place among philosophers and men of genius. Much of the fame of this Essay is no doubt traceable to the eloquent exposition of its doctrines given by Lord Jeffrey in the *Edinburgh Review*, but the theory of beauty it propounded, is Dr. Alison's own.

*Statue of Lord Collingwood.*—A statue of Lord Collingwood has recently been completed by Mr. Lough. The material is stone, and the height of the statue is 23 feet. It has been placed on a pedestal about 50 feet high, on a plot of ground belonging to the Duke of Northumberland, at Tynemouth, close to the place of Lord Collingwood's birth, and is seen well from the sea. The cost of this memorial of one of England's Naval Worthies has been defrayed by public subscription.

*Luther's Sacramental Cup.*—The King of Prussia has just bought the wine-vase and the cup with which Luther used to administer the sacrament. They are of silver, gilded in the inside. The cup resembles an ordinary goblet, but is more oval than round; the vase has the form of a jug, and is of admirable workmanship; it is covered with subjects representing the passion of the Saviour.

*Summary*—The annual exhibition of the works of modern artists at the Louvre will be opened on the 15th of March next, and closed on the 15th of May. All works intended for exhibition may be sent in between the 1st and 30th of February.—The Viceroy of Egypt is about to found at Cairo a school of the Fine Arts. His chief object in creating this institution is, it is said, to disseminate amongst his subjects a taste for the study of all things relating to Egyptian architecture. It is reported that M. Garnaud, a French architect, is to be placed at the head of this institution. —The rebuilding of Lord Francis Egerton's mansion, in Cleveland-square, formerly belonging to the late Duke of Bridgewater, is to be commenced early in next march. Mr. Barry is the architect of the new structure.— The monument erected to the memory of Louis XVIII., in the vaults of the Cathedral of St. Denis, in Paris, is about being completed, and, when finished, that of Charles X., his successor, will be proceeded with. When this is done, all the French kings and princes up to 1830 will be there reprusented either by a tomb, a monument, or a statue.—A subscription has been set afloat for the purpose of re-pewing and effecting other improvements in St. Michael's church, Coventry. The required outlay is estimated at 5,000*l*. —Twelve statues representing Art, Industry, Sciencce, and Commerce, have been of late placed on the balustrade at the top of the Paris Hôtel de Ville, facing the Rue de la Tixéranderie; and three of the façades of the building are now ornamented in that way. When the Paris Guildhall is completed, it will contain about 500 statues, busts, and allegoric medallions.—A syndicate is about to be appointed at Cambridge, for the purpose of ascertaining in what manner a tax may most conveniently be laid on the members of the university with the view of forming a new botanical garden. Already several suggestions have been made, having for their object such architectural improvement of the town as the projected change will admit of.—The repairs and decorations now in progress at the Liverpool town hall, will cost about 5,000*l*.—The Picture Gallery of Dresden, the depositions of the Madonna del Sisto of Raphael, and other incomparable works, is now likely to be replaced by a building more in accordance with the demadds of our age. The cost is estimated at 350,000 thalers, about 37,000*l*.—We learn, from the Roman States, that the frescoes with which the celebrated Luca Signorelli had adorned the vault of the Cathedral of Orvieto having long disappeared under a thick coating of soot, two young Germain paintes, MM. Bothe and Pfannenschmidt, natives of Wurtemberg, undertook, at their own cost, and solely for the love of Art, to restore these paintings;—in which they have had complete success. The municipality have rewarded the artists with the freedom of their city; and are about to publish engravings of the frescoes,—dedicating the proofs to them.—The government of Bavaria has bought the collection of antiquities, in *terra cotta*, of the Swedish sculptor Fogelberg—better known as the Chevalier Benedetto.—The ceremony of laying the corner stone of tbe Cathedral of St. John's, Antigua, was performed on the 9th of October, by his Excellency Sir Charles Fitzroy, the Governor-in-chief. The Cathedral will be in the form of a cross, and will accommodate 2,200 persons. The length is 156 feet from east to west, and width, 50 feet. The length of the transept is 104 feet, and width, 46 feet. Two towers will be erected at the west end, each 70 feet high, crowned with cupolas. The enterior ceilings of the aisles will be flat and panelled, and that over the nave will be coved and pannelled, and supported by 64 columns and pilasters. The building will of freestone, with an inside frame of hard wood, lined with pitch pine, the whole of which will be varnished. The windows will be glazed with stained glass; the seats will be of pitch pine; the pulpit, lectern, bishop's throne, and stalls will be of mahogany; the style of architecture, Roman. —The Grand Duke of Baden, on the occasion of the resignation by Herr Creuzer of the professors's chair which he has filled in the University, Heidelberg, for thirty-four years, has graeted to the ii ustrious archæologist letters of personal nobility.—The inauguration of the Count de Nieuwerkerke's statue of William the Taciturn took place at the Hague, on the 17th ult.,—the King unveiling the figure with his own hand. His Majesty presented to the sculptor, on the occasion, the Cross of Commander of the Order of the Oaken Crown; and made M. Soyer, of Paris, who cast the bronze, a knight of the same Order.—In consequence of the abolition of the glass duty, a great improvement is being carried out at the Quadrant, in Regent-street, by removing the roof of the colonnade to substitnte one of glass. From the darkness of the shops, the original design of forming a promenade, garden, or conservatories on the terrace was necessarily given up, in order to cut skylights, &c., of divers sizes and forms. It will now be uniform, and be convenient both to the shopkeepers and customers.— The restoration of the interior of the nave of the Holy Trinity Church, Hull, is now completed. The galleries have, with all the modern pews upon the ground floor, been taken away; the entire area of the nave cleared of every thing; and the stone-coloured paint removed from the lofty piers, their capitals, and arches. The panels of the ceiling have been painted with ultra-marine, whilst the members of the beams are "picked out" in colours, crimson and gold. The centre of the panels is studded with gold stars. In different parts of the roof are painted illustrations of the instrument of our Lord's passion, with monograms, &c. Soue of the richly-carved capitals of the columns of the nave are decorated with crimson and blue and gold. The whole of the embellishments of the ceiling, &c., were done by Messrs. Binks and Son, of Hull, after the designs and under the superintendence of Mr. Lockwood.

RAILWAYS.

*Protection against Railway Litigation.*—Several meetings have been held of persons interested in railway enterprise, with the view of adopting measures for resisting the legal proceedings that are threatened by various railway companies by an association for mutual defence. One meeting took place at the offices of Mr. Harrisan, 5, New Inn, when it was mentioned that various buble companies have declared their intention to sue for the amount of deposits on letters of allotment. Another meeting, with the same object, has been held at Messrs. Amorys' Offices in Threadneedle Street. Mr. Colling, M.P., in the chair; and a third has been called at the Londnn Tavern, by Mr. Coode. It ffias been suggested that snch associations are illegal, as bəing an infraction of the laws against maintenance.

*Winding up of Unsuccessful Schemes.*—The Brighton and Cheltenham Company, who, at a recent meeting, announced their intention of returning the deposits, less ten shillings per share, have issued a notice, iuforming the shareholders that thəy could not fulfil their engagements, in consequence of a bill in Chancery having been filed against them.—The West Midland, Manchester and Southampton Railway notify to their subscribers, that "the failure in the payment of deposits having rendered it inevpedient to attempt the completion of the project, the dirəctors have resolued on returning the entirə amount of thə subscription paid."—The committee of the Middlesex and Surrey Junction Railway have resolved to return the deposits, and have called upon the provisional committee to contribute each 30*l.* towards the expenses, beyond which the managiug committee themselves engage to make good all deficiencies.—The Grand Junction and Midland Union scriphoiders are to receive back the sum of 1*l.* 1s. per share, the remainder is to be a deposit till a future period, when the committee will state the course with reference to the prosecution of the unertaking and the deposits.—The Dudley, Madeley, Broseley, and Ironbridffe Railway have decided, in consequence of the failure to lodge the plans and sections in due time, and their generally defective state, *not* to proceed with the scheme in the next session, but to return to the shareholders 2*l.* per share, reserving what remains of the deposit (12s. 6d. per share) to meet the expenses.

A memorial has been presented to the Woods and Forest Commissioners, by the inhabitants of Regents' Park, praying that the projectcd conversion of the Regents' Canal into a railway may not be suffered to take place.—Tbe principal engineers are stated to have their shares of the now projects in the following proportiou: Mr. Brunel is connected with 14, Mr. Robert Stephenson with 34, Sir James Macneil with 37 (chiefly Irish), Mr. Locke with 31, Mr. Vignolles with 22, Sir John Rennie with 20, Mr. Rastrick with 17, Mr. Miller with 10, Mr. Gravatt with 10, Mr. S. Hughes wiɀh 9, Mr. W. Cubitt with 11, Mr. Gibb with 12, Messrs. Birch with 7, Mr. Blunt with 8, and Mr. Brithwaite with 9.—Punch announces the publication of a book to be called "Thə Retreat of the ten thousand Directors;" the Wesiminster boys. too, in one of their Lain plays caunot refrain from a quiz, by the application to the railway mania of the saying "*Nulla dles sine linea.*"—A breach seems to have occurred between the South Western and Great Western Companies respecting the Exeter projects of these lines, which is not likely to be settled before the matter is brought before the Board of Trade,—It is estimated that from the prorogation of parliament, up to the time of depositing the plans 106,000*l.* a week have been spent in railway advertisements,—A locomotive engine with several persons has at last passed down on the South Devon line, from the commencement at Starcross, for the purpose of consolidating the earth-work preparatory to laying down the atmospheric tubing.—The first sod has been turned on the Bedford and Birmingbam line. at Brockborough-hill, about the centre of the line. The ceremony was performed by the Duchess of Bedford, assisted by Lord Alford, the Duke of Bedford being unable to attend.—The Peterborough, Lynn, and Boston is advertised as my "Lord Fitzwilliam's" line.—The Havre Company have held a social general meeting. The heavy expences thrown upon them in the purchase of land, by official chicanery, at every stage of their works, have compelled them. even before the rough draught of the line is completed, to call for more money.—At a meeting of the shareholders of the direct Brighton and Cheltenham, the chairman stated. with astonishment, that a fee of 400 guineas had been paid to Sir John Rennie as a "retaining fee," in ordrr that some supposed competitor should not secure his services.—The directors of the South Devon have succeeded in raising 200,000*l.* on debentures, at a less sum than they would have to pay the shareholders; there will be no further call at present.—The rumour that the Oxford, Worcester, and Wolverhampton line would not be carried beyond Worcester is contradicted—The committee of the Hull Stock Exchange have, for some days, published on their lists the names of several of the repudlators of shares in the Barnsley Junction. Threats of similar exposure are held out to other defaulters.—The company of the Fampoux and Hazebrouck railroad has signed contracts for the execution of the entire of the works, and the supply of the rails, sleepers, cross-timbers, engines, and waggons. The contractors of the works has undertaken to complete them witnin 14 months after being placed in possession of the ground. The rails are to be furnished by the forges of the Denain, at tha price of 36f, per metrical quintal; and the sleepers by those of Marquises, for 25f. M. Andre Kœchlin is to construct the engines, and M. Hallette the corrirges; the former, 18 tons in weight, are to he built on the last models of Stephenson, and to cost 45,000f. each.

CONSTRUCTION.

*Fall of three Houses in the Wandsworth Road.*—In no place in the civilized world, perhaps, are there so many tottering houses built as in London. The new building act, while it creates vexatious obstructions, and shamefully amerces the public, appears to have conduced, so far at least, but little to a higher degree of security, and with a swarm of hungry surveyors and a whole cageful of referees, whose only chirp is "money," we have as bad houses built as ever. Of such fragile stractures we have a specimen in three houses which lately fell in the Wandsworth road. Mr. Corrall, a builder, had recently erected four six-roomed houses with shop fronts, in Cavendish-placc. They had been covered in, and the lathing and flooring had been completed, but there yet was some plastering and other matters to be done. Oliver Carroll, the son of the builder, who was only in his twentieth year, his brother, and a lahourer, were at work on one of the basement-floors of the houses, laying coucrete, when, as it is supposed, the end wall of the house nearest the Cavendish Arms, bulged out, and in less than a minute the three houses separated from the fourth, which was apparently much more strongly built, and fell with a loud crash, burying in the ruins the two brothers, the labourer escaping with a few bruises from the falling bricks. One of the Carrolls was killed; the other escaped with some injuries. The materials of the houses were of a very common description, the mortar especially seemed to have been made without the requisite quantity of lime, for there was scarcely a brick to which it adhered. The concrete which had been put at the foundation, about twelve months before, were very inferior, and had never set or become sound. We do not say that in this case the fall of the houses was immediately caused by the badness of the materials, for it appears some earth had been removed from the foundations, to which the calamity was directly attributable; but the result showed that the very worst materials had been employed; and it does not appear probable that the houses would have fallen had they been properly constructed.

*Baths and Wash-houses for the Industrial Classes.*—The ceremony of laytng the foundation-stone of the first model establishment for baths and wash-houses for the labouring clasees in Gulston-square, High-street, Whitechapel, has just taken place. The Lord Mayor presided on the occasion; there were also present Mr. Wm. Cotton, the chairman of the committee, Mr. Wm. Weire, as deputy chairman, tho Rev. Mr. Quiakett, &c. The stone having been lowered, thc lord mayor went through the process of "laying the stone," on which was fixed a brass plate with the annexed inscription:—"The first stone of this building, erected for baths and wash-houses for the labouring classes, was laid by the Right Hon. John Johnson, lord mayor; the Right Rev. Lord Bishop of London, president; Wm. Cotton, Esq., chairman; Wm. Hawes, Esq., deputy chairman; P. P. Baly, Esq., engineer; T. Buller and T. Forrest, Esqrs., honorary secretaries; and G. S. Griffith, Esq., assistant secretary." A glass bottle was also inlaid, in which were deposited the silver and copper coins of the realm, a dinner ticket, and the report of the committee. In the evening, upwards of 240 gentlemen celebrated the event by dining together at the London Tavern; the lord mayor took the chair. In the course of the evening donations were announced amounting together to about 1,000*l.* The committee announced at the outset their intentiou of erecting at least four model establishments in the metropolis, and we cannot doubt either thcir determination to keep faith with the public, or the willingness of the public eventually to raise the requisitc funds. The time which has been devoted to the completion of the plans for the first model establishment has been spent once for all. Those plans, with mere trifling modifications, will, of course, suffice for the buildings which are to follow; and we hope very soon to have the pleasure of recording the laying of the second foundation-stone.

*Destruction of Market-sheds by the Wind.*—The roofs of the sheds in course of erection at the new market, in Carmarthen, have been swept off by a violent gust of wind. The accident occurred at night, and on the following morning a strange scene of havoc presented itself; huge beams were split like laths, iron pillars snapped in pieces, iron bars bent almost circular, and, in fact, every particle of this portion of the building completely demolished. It is calculated that the damage cannot be repaired under 100*l.*, and that a delay of about a month will take placc in the completion of the market. It appears that the iron pillars supporting the roof are merely connected with the stone on which they stand by being inserted about one inch in depth with it, the stone itself being only a foot deep, although built on solid brick-work. This species of attachment can hardly be considered efficient in the case of a structure which may be raised by the wind. The pillars ought obviously to be secured by holding down bolts to the foundations—the weight of the foundations being made sufficient to resist any elevating action of the wind on the roof. The best and cheapest foundations for the pillars would have been screw piles of cast iron, which resist both an upward and a downward thrust.

*Bursting of an Embankment on Lough Corrill.*— An embankment lately raised by the Lough Corrill Improvement Company, extending from Suckeen to Tyrriland, in the west of Ireland, has given way; the Tyrriland bridge has been broken down, and the whole of the adjacent lands have been flooded. The immediate cause of the disaster was the rise of water consequent upon heavy rain; but the embankment appears to have been unskilfully constructcd, and much dissatisfaction is expressed with the improvement company for interfering in the affair at all, as tfie drainage of the lands would otherwise have been accomplished effectually by the Irish Board of Works.

*Alterations in the coast fortifications.*—The alterations of the old fortifications, so as to mount from sixty to seventy guns of the largest calibre, which have been impeded for some time, owing to the experiments recently inrtituted at Woolwich as to the best mode of pivotlng the carriages for the guns, to determine whether or not they are to be secured to the masonry, are about to be recommenced with vigour; the result of these experiments being in favovr of fixing the platforms by pivots to the masonry, which must necessarily be strong to bear the recoil of such enormous guns as are now intended ta be placed on all our fortifications. The excavations for the masonry on which the several traversing platforms are to rest are now beiug bedded with concrete, and the greater part of the stones are already hcwn and ready to lay down. We should like to see the steam-gun tested in some of the fortresses at the mouth of the Thames. A single steam-gun discharging balls in a stream, and set upon a universal joint, would be as effectual as several hundred guns af the ordinary description. Why is not Mr. Penn requested to undertake the construction of a gun of this description? He would probably undertake the task if requested by the Admiralty to do so; and in his hands it would be sure to succeed.

*New Iron-works in Fifeshire.*—The extensive iron-works now in course of erection at Oakley, Fifeshire, are deserving of notice. The engine-house is built ef stone from the new Carnock quarry, and is forty feet below and fifty feet above the surface ground. The lever wall, which runs across the building from the foundation to the top, is ninety feet high, and about six feet in thickness. It is built of polished stones of enormous size, each block being three tons in weight. In this building there are deposited 60,000 cubic feet of stones below the surface of the ground. The next most conspicuous objects are the furnaces, two of which are far advanced, the chimney-stalks being each about 180 feet in height. New iron works are now starting up in a number of different places, both in Scotlaud and England, and they can hardly fail to be profitable if the railway extension goes on.

*Destruction of a Railway Embankment by the Sea.*—Part of the Furnys railway having to run along a marsh called Sathouse Marsh, which is covered by high tides, an embankment was formed on which to lay the rails: during the latc gales, the sea has swept entirely away the whole of the embankment, doing damage to the estimated amount of 2,000*l.* The work will not be resumed this winter. Although the tides were considered to rise high this week, the water has been known to rise higher in previous winters by twenty-five feet.

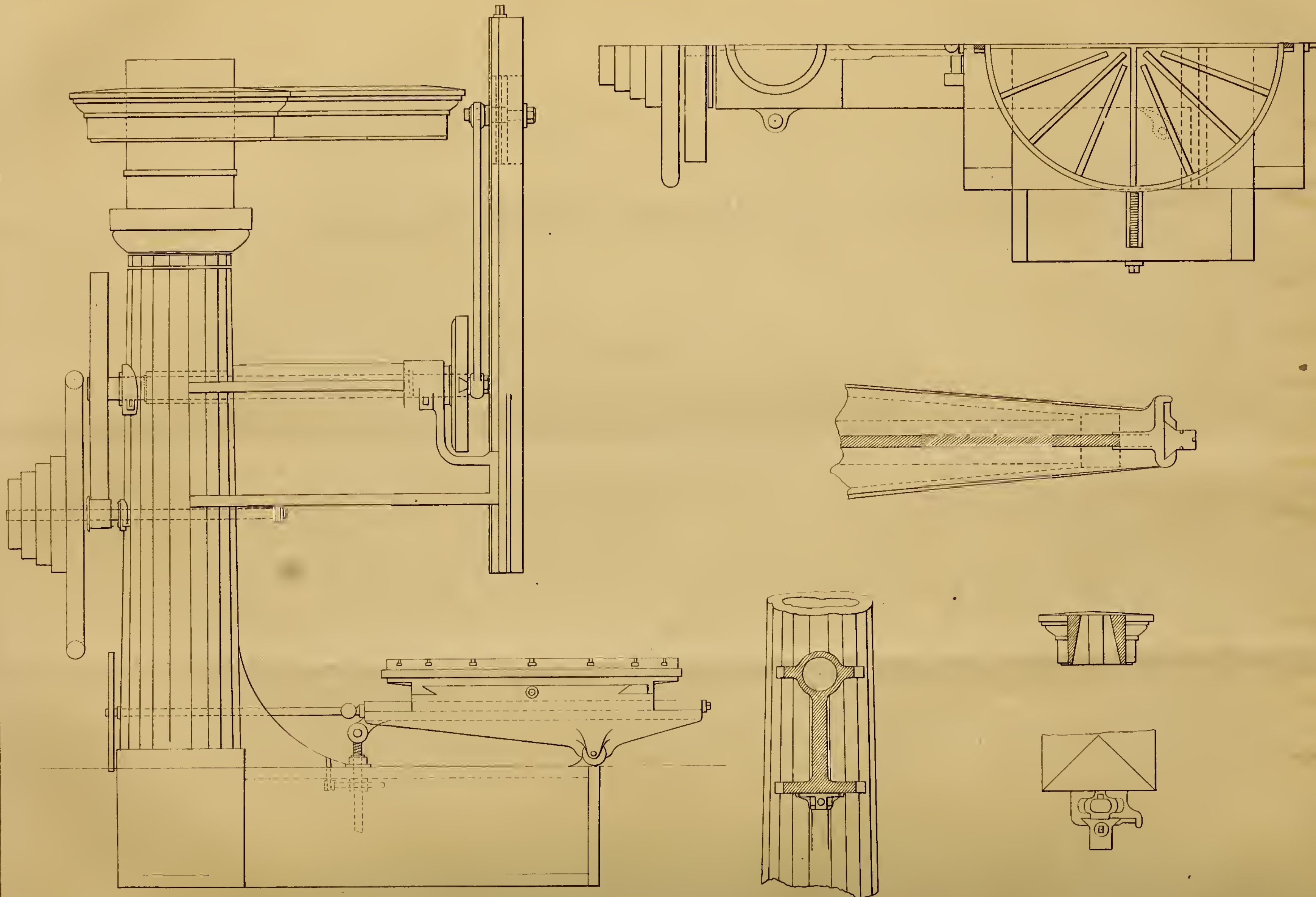
*Antiquity of the Skew Arch.*—Although the skew arch has only come largely into use of late years, the method of its formation was known many centuries ago to the oriental architects; and its first contrivance probably ascends into a higb antiquity. In a narrow street at Seville, leading from the Cathedral to the Puerta del Xerez, is a skew arch built by the Moors at least eight centuries ago: other examples will probably be noticed as the attention of travellers becomes devoted to the subject.

### CONSTRUCTION SUMMARY.

A letter from Berlin, of the 13th, states, that the King of Prussia has authorized the building of a second Catholic church in the capital, and permitted a collection to be made for the purpose in all the Catholic churches in the 7ingdom, without prejudice to the sum which his Majesty intends to contribute.—A party of influential geutlemen are attempting to found in the metropolis a Provident Association for the benefit of aged and decayed members of the above professions. Mr. J. Bailey, of 9, Gray's Inn Square, has consented, during the initiatory proceedings, to perform the duties ae honorary sacretary.—The different lines uniting at Leeds are reported to have agreed to contribute 100,000*l.* each towards the establishment of a centrnl station.—At Chester, on the line to Holyhead, two bridges are in progress—the one across the Der, and the other across the canal. About 300 men are employed near Chester; about 200 more are engaged at Mostyn; near Conway the same number, chiefly in making the tuunel through the rock; and about as many in the neighbourhood of Bangor.—An immense number of workmen are employed on the Lancaster and Carlisle line. The embankments and cuttings are very heavy, and the process of blasting large quantities of stone that obstruct various parts of the line is still continued. The lengthened embankment near Carlisle is completed, and the viaducts at Gatthie are nearly formed.—A plan for the extension of Folkestone by the erection of a considerable number of houses on Lord Radnor's land, was submitted, a few evenings since, to a public meeting of the town's-people, called by the mayor, G. Robins, Esq. The scheme, as explained by the originator, is on the prinliple of a building society, by the operation of which each member will, in succession, become possessed of a residence in eleven years,—The Barrow viaduct on the Lancaster and Carlisle line is nearly finished. The viaduct spans the romantic valley of Borrowdale near its junction wıth that of the Lune, at an altitude of 68 feet, and is built of a light red freestone, except the interior of the arches, which is composed of brickwork.—The Commercial Bank, and the new branch of the Bank of England in Castle-street, Liverpool, are both to be built of stone, brought from the Darley Dale Quarries, Derbyshire, from whieh also was procured the stone used in the erection of the Liverpool Assize Courtt.—The electric telegraph is now completed between Doveo and Edenbridge, as well as between the latter place and Maidstone. It will be coutinued from Edenbridge to the London Bridge terminus and the Bricklayers' Arms station.—The great tunnel in the Sheffield and Manchester line, nearly three miles iu length, is nearly completed.—There will be eleven embanements and ten cuttings on the Brighton, Lewes, and Hastings linc. Mr. Kirby. the resident engineer, reports as follows on the same:—Redditch embankment, which is formed, contains 19,700 cubic yards; Redditch cutting, completed, 11,800; Stonecross cutting, 106,900h 54,000 removed; Westham cutting, 14,700, completed: Pevensey Marsg, embankment (3½ miles long), 50,000, 36,000 removed; Conden cutting 13,000, completed; Little Common cutting, 25,800, 4,000 remove00 Hatland cutting, 8,800, 4,000 removed i Bexhill cutting, 71,800, 37,0he removed; Galley Hill cutting, 52,500, 44,000 removed; Bulverhitnc cutting, 32,800, 27,600 removed. The deepest cutting is that of Stonecross, which is 40 feet, and the highest embankment averages 23 faet. The portion which passes through the ruins of the priory of St. Pancras, at Lewes, is somewhat impeded by the care exercised in the excrcised in the excavations. The works do not mnch disturb any of the walls of the ruins.—On the Eastern Counties line, the erectiyn of a new and enlarged station at Cambridge, nearly half a mile nearer the town, has been resolved upon Improvements haue been made at the Shoaeditch terminus by the completion of a new suite of waiting rooms for the passengers. The new statious at Brentwood are almost completed. They are bnilt of red brick, in the Elizabethan order.—A lighthouse is to be raised on the coast at Fatouville near the mouth of the Seine, in place of the wooden one now existing. It is to be 96 mêtres above the highest equinoctial tides. The cost will be 145,000*l.*—Within the last fifteen years upon the property of the Marquis of Bath, Wiltshire, no less than seven Churches have bcen either re-built or newly founded, and nine school-houses erected, involving together an outlay of nearly 30,000*l.*—The house of the famous Jewish philosopher, Moses Mendelssohn, has just been purchased for 35,000 dollars by the Jewish Commune in Berlin; it is to be converted iuto a free school, for the education of poor Jewish children.—A public meeting was held last week at Ely, having for its object the erection of a Corn Exchange there. The market hill wsll most probably be selectod for the site, in which case an unsightly patch of old houses will have to be pulled down. The estimated expense is 6,500*l.*—The *J oarnal des Debats* states, that the iron suspension-bridge in construction at Choussin (Jura) had been entirely carried away on the 9th of December, by the extraordinary rise of thc waters.—A local paper says, the directors of the South Shields Water-works purpose, if three thousand families will agree to take the water, to supply the working classes of the town with water *ad libitum* at the rate of a penny per week.

# Slotting Machine.

2 ft. 6 in. Stroke.



F. Mansell sc.

# THE ARTIZAN.

No. XIV. New Series.—FEBRUARY 1st, 1846.

## Art. I.—POLICY OF THE WORKING CLASSES IN THE PRESENT CRISIS.

1. *Remarks as to the measures calculated to promote the welfare and improve the condition of the labouring classes, more particularly in connexion with the future prospects and interests of landed proprietors and agriculturists.* By a Member of the Aristocracy. London: Dalton, 1845.

2. The *Quarterly Review*, No. clxiii.

Free trade is now in the ascendant. The strongholds of monopoly have been successively forced by the battalions of the League, and before these remarks meet the public eye, the doom of protection will probably have been pronounced by the minister. A change so momentous can hardly fail to have an important influence on the welfare of the labouring classes, and it behoves us to enquire what the line of policy is which they ought to pursue at the present crisis. Those of our readers who have attended to our former expositions, will remember that we have always been in favour of free trade, but our opinion was, and is still, that colonization on the large scale, would be preferable, so far as the working man is concerned, inasmuch as it would give him all the benefits of free trade, with an exemption from the burden of taxation, by which in this country he is oppressed. The alternative, however, we have always held to lie between large and systematic colonization and free trade; all expedients must be unavailing towards improving the artizan's condition, which does not either increase the amount of profitable work to be done, or diminish the quantity of labour in the market; and although we should have preferred colonization as being best for the operative, we gladly accept free trade as the next best and only other remedy, while it is certainly the preferable alternative for England. We cannot say indeed that we have much faith in the motives of the League, though it professes so much solicitude for the welfare of labouring men: we believe, with the *Quarterly Review*, that substantially the movement is a selfish one; but what the working classes have now to consider, is not what the motives have been of the League's agitation, but what will be the effects of that agitation so far as they are concerned? It appears very clear to us that free trade will give a great impulse to manufacture of every description: England will become the workshop of the world, and wages will rise with the increased demand for labour—the price of labour being always dependent on the velocity with which the demand for it increases. And if the demand for labour be great, workmen will be able to make better terms with employers than they have yet realized: they may prescribe shorter hours of labour, and other equitable alterations, and in every equitable demand, if respectfully and temperately urged, they must be successful.

But if free trade be carried, what is to become of the aristocracy? This is a serious question, and one which the working classes are concerned in having answered, for we do not conceive that it would benefit the working man to have a generation of cotton-spinners exalted into national dictators. The example of Venice does not afford much temptation towards the creation of a similar oligarchy, and working men well remember the course pursued by the leaders of the League on the Short Hours' Bill, notwithstanding all their professions of philanthropy. The aristocracy, it is true, have fallen shamefuly short of their duties; and the unhappy condition of the rural labouring population, and their own general pride and supineness, deserve any punishment the League can inflict; nevertheless the working classes do not perceive that it would be to their interest to suffer the aristocracy to be overborne in the approaching struggle, which they certainly will be, if the working classes do not sustain them. The iniquity of the corn laws has been so clearly shown, that they now stand before the bar of public opinion as convicted plunderers, and what is the worst of all, as plunderers of the poor. Their attempts at vindication have only shown that there is as great a dearth of talent among them as of honesty, and their fruitless struggles have made manifest to all the world their poverty and want of power. The League aspires to take all political influence out of the hands of the aristocracy, and with the aid, or even the neutrality of the working classes, they would certainly accomplish their object. But the cotton-spinners would be the aristocrats then standing, too, in an antagonism more immediate than that occupied by the generation of Dukes and Viscounts; and the interests of the working classes suggest that they should not prevent the extinction of either party, but play the one against the other. The working classes will not therefore permit the aristocracy to be put down, but neither will the working classes assist them in maintaining the corn laws; and if they are wise, they will give up the corn law with as good a grace as possible, and then fortify their position with such aids as the working classes are willing to render. The Young England party have long seen that unless the working classes be brought to their succour the aristocracy must be overthrown, but the alliance can never be that of seigneur and serf, but of free and independent powers, conspiring for a common object. "The gentle pressure of the feudal chain" will never again be tolerated by the British artizan, and to attempt the imposition of such fetters can have no other effect than to complete the alienation of the working classes, and to drive them into the ranks of those by whom the destruction of the aristocracy is sought to be accomplished.

The author of the remarks respecting the means of improving the condition of the labouring classes appears to belong to the Young England party. He carries, we fear, but little weight of metal, but he appears to be sincerely desirous of cementing a league between the extremes of society, by friendly offices, and timely concession. He looks upon the maintenance of protection as a hopeless and unwise experiment, and expresses his belief that the landowners will not be damaged by abolition of the corn laws, inasmuch as by the introduction of superior methods of agriculture, the production of corn will be approximated to a manufacture of which the land may be regarded as the plant. He speaks in high terms of the benefits of returning to spade husbandry as a means of increasing production, and giving additional employment to the people—an innovation which it appears clear to us will not do, as if the spade labourers were well paid it would be impossible for the landowners to keep their lands under cultivation, and if the wages of the labourers were to be rendered sufficiently low to make the cultivation of the land possible, the creation of a horde of miserable serfs would be the inevitable consequence of this improvement. It is to the aid of machinery the landowner must look to enable him to maintain a competition with countries less oppressed by taxation; and if machinery has enabled the British manufacturer to make the world his tributaries, and rise above the competition of other nations, there is no reason why the landowner should fail to make it subservient to the same benificent purposes. It is true, indeed, that the superficies of the land is limited and we cannot multiply fields in the same manner that we multiply machines; but by the resources of chemistry, and mechanical science, we may greatly increase the rapidity of production—just as a power-loom has been made to yield many times the quantity of cloth that the hand-loom could yield; and if, notwithstanding the lowness of wages in India, we can by the powers lent to us by machinery, sell our muslins at a lower rate there than the native manufacturer can produce them, it can hardly be called an outrage upon our faith if it be deemed possible that by the powers lent to us by machinery in agricultural production we may hereafter export corn to countries which rely on the primitive modes of cultivation at present in use. It may, indeed, be contended that it is time enough to remove the existing protection when these grand improvements have been effectually worked out; but it is the nature of all protective laws to hinder improvement, by making men trust to acts of parliament instead of their own exertions for carrying them on to fortune. All experience shows us that protected interests are sickly, and are deficient in the element of economical production. The *Standard* endeavours to derive an argument against the popularity of the free trade movement from the fact that *The League* newspaper is carried on at a loss of £10,000 a year, but the fact rather appears to us to show the inevitable injury of protection—the newspaper in question being virtually a protected one. Government gazettes and other similar publications do not nearly return their expenses, simply for the reason that the motive for economical productions is diminished or taken away; and it is the vice of all protected interests that in the race of improvement they fall behind. The abolition of agricultural protection will therefore bring its own reparation: under the stimulus of competition improvement must advance with giant strides, and the diminuition in the price of corn will be far more than made up to the land-owners by the increased production. Whatever be the effect to the land-owners however, protection must now be brought to a close; and we humbly conceive that the aristocracy should yield with some show of magnanimity to a neccessity they cannot resist; but it may facilitate this difficult determination to remind them that there is a compensating power in nature which redresses every act of injustice by the infliction of a corresponding penalty—the penalty of agricultural protections being, the inevitable death of enterprise, and the cessation of improvement. We must, however, now proceed to examine the arguments put forth in favour of protection by the *Quarterly Review*, which has just come to the rescue of the protectionists with an article on "ministerial resignations," containing arguments which many regard as unanswerable.

The most plausible of the arguments in favour of agricultural protection appears to us to be that if any material part of our supplies of corn were derived from abroad we might be reduced to the greatest straits from the supply being cut off by war. "The sure andregular supply of corn is," the *Quarterly* says, "the real and only justifiable object of that protective system, which, instead of alternate gluts and famines, and corresponding fluctuations of work and wages, is calculated, so far as human laws can operate, to correct the vicissitudes of seasons, and to preserve a steady supply and moderate demand. This object, it is maintained, has been effectually obtained by the sliding scale— whereas recent experience of the sliding scale shows that when there is much damaged corn in the market, a very high price for good corn may co-exist with moderate average prices, the price of the damaged corn being necessarily low; and in such cases the sliding scale fails to perform its intended function. This, however, is only a point of detail: the following is the *Quarterly's* argument for the principle of protection:—

> An unrestricted introduction of foreign corn would in a few seasons reduce this proud and prosperous empire, now the envy of the world, to a wretched dependence, not merely on the seasons, but on the policy of Russia and Prussia, America or France. When a few years had unstocked our farms, ruined our farmers, thrown out of cultivation millions of acres, and rendered the whole nation pensioners on foreign countries for the "*daily bread*" that heretofore they have asked only from God and their own resources—when, we say, we shall be brought to that state, and that Prussia, or France, or America, or all three, should take any umbrage at us (for humbled as we shall be, and sore afraid to offend our feeders, we shall learn the fatal lesson that, amongst nations, humiliation and dependence will not avert wrath nor assuage vengenace)—when, we say, that day shall arrive, how will they attack us? Will they allow us to meet them at La Hogue or St. Vincent, Blenheim or Waterloo?
>
> Will rival navies give the fatal wound,
> Or hostile armies press us to the ground?
>
> Alas! no; they will have recourse to the cheap warfare of shutting their ports—to a short campaign of custom-house embargoes;—reject our manufactures, refuse us their corn, and reduce us by starvation and anarchy to a state of national decrepitude, if not subjection. Let us not be told that we invent or exaggerate this danger. A few years since there was, about September, a prospect of a bad harvest in England; France immediately laid an embargo on all her western ports from Dunkirk to Bayonne. At the first symptom of our present deficiency the whole Continent has either closed their ports altogether or imposed prohibitory export duties; there was as strong a party in France insisting upon the entire shutting her ports, as there is here for opening ours; and there have been serious riots along the Channel coasts of France, on the suspicion of some attempts at an export of corn to England.

We are not sure that this argument, whatever weight may be attached to it by the holders of property, is one that concerns working men. What could it signify to them although possession were taken of this country by France or America? Would their condition then be worse than it is at present; or can it be any answer to the multitude in their demand for bread, that America will take the country unless they starve in silence? It appears, however, to us, that even as regards the possessors of property, the argument is without cogency. It is no doubt the fact, that a country dependent on foreign supplies of food may, if it can be besieged like a town, be starved into submission: and during the last war, Norway was brought to terms she had previously rejected by a flotilla of gun-boats, distributed along the coast, which intercepted the supplies of food. But, before Britain can be thus laid siege to, she must have lost her place among the nations; for the interception of her supplies of food, even were she wholly dependent for them upon foreign countries, would not be more fatal than the interruption of her commerce: and either can only spring from the loss of her supremacy upon the ocean. America, indeed, or any other power with which England was at war, might prohibit the exportation of corn from its territory; but England would still have all the rest of the world available for its supplies; and even the corn of the belligerent state might be bought by England in the market of neutral states to which the supplies of the world would flow, so soon as the purchases of England had raised the prices. The prohibition, in our hour of need, of the export of corn from France and the other places referred to, only shews the impolicy of the sliding scale, which is based on the assumption that there is an unlimited supply of corn in foreign countries, ready to be introduced into England on any emergency; but when the emergency comes, it is found that there are no such supplies available; foreign countries, in the absence of a certain market, having only raised corn enough for their own consumption. France would not have objected to supply England, had she not apprehended that the abstraction would occasion scarcity in her own dominions; which scarcity, and therefore which refusal, could not, in the common course of events have arisen had France been in the habit of supplying England; as she then would have possessed more corn than was requisite for her own consumption. At the present moment, the price of rice in India has been doubled, not by deficient harvests, but in consequence of large exportations to meet the emergency in England; and France, by her restrictions, has merely desired to shield her people from the inconveniences incidental to such sudden fluctuations, which, but for the sliding scale, could not exist. Seasons of scarcity will, no doubt, from time to time occur, of which we must feel the effects, in whatever country the corn we consume is grown. But in proportion to the increase in the sources of our supply, the risks of a deficiency are diminished, for deficient harvests are but local afflictions, and we have no experience of such a phenomenon as a universal dearth.

These considerations are, we believe, a sufficient answer to those protectionists who conceive that the security of England will be compromised if she is made dependent for food upon foreign nations: it is not difficult, however, we think, to show that the precautions they recommend would certainly produce the dangers they deprecate. The numerical strength of a nation is ultimately referable to the supply of food it possesses; and the population of England must, with our present agricultural resources, speedily reach its limit, if the importation of food from foreign countries is prevented. While, however, the growth of England is arrested, that of Russia, America, and other countries will proceed with an accelerating velocity; so that England must be outrun in the race of progress, and speedily subside into a secondary power. This calamity may, no doubt, be averted by such improvements in agricultural productions as will enable our own supplies of corn to satisfy the wants of an increasing population; but such improvements can only grow up under the open sky of free trade competition; and protection must be abolished before they can even germinate. The realization of these improvements will make protection superfluous, so that its abandonment cannot be productive of injury to any party; while, if it were possible that the present system could be persisted in, the glory of England would fade away in the brightening lustre of younger nations, and the sceptre of the world would be wrested from her grasp. The injury sustained by the Roman Empire from its dependence upon distant countries for its supplies of food, which were eventually discontinued, finds no parallel in the condition of England; for Rome produced nothing wherewith to buy these foreign supplies, but was merely a nest of powerful robbers, who were necessarily starved so soon as they had lost the ability to plunder. But we need not dwell longer on these arguments, which are but the small ingenuities of interested men. The starvation of a siege cannot be agreeable to any part of the community; and our merchants, manufacturers, and other holders of capital, are certainly quite as jealous of the honour and authority of England as the holders of land; yet we find all the doubts and deprecations of a change come, at the present moment at least, from one party, and that party is one which believes itself to have a private interest in the maintenance of the present system. If the importation of foreign corn were a public evil, why should the public voice refuse to recognize it as one; or why should the owners of land be the only enemies of the innovat'on? The cloak of patriotism they put on is, we fear, of too flimsy a texture to hide from any the ignoble selfishness which lurks underneath.

The *Quarterly* maintains, that if the corn-laws were abolished, land would go out of cultivation to an extent estimated at twelve millions a year of rental; and that we must be overwhelmed by the burden of the national debt, when deprived of the prop of agricultural prosperity. It is very clear, however, that the twelve millions a-year we spend in the purchase of foreign corn must be paid in our manufactures, for we produce nothing else to pay the amount with; and the effect of the measure will therefore be to transfer agricultural labourers to the manufacturing districts, where they will receive higher wages than before, as the amount now paid to the landlords as rent will be divisible between the manufacturers and the working classes. As regards the national debt, it is sufficient to remark, that the removal of a load from the national industry cannot make the nation poorer than before, or less competent to fulfil its just engagements; and that the most feasible method of easing the burden of the national debt is to suffer the nation to outgrow it. The *Quarterly* protests against doing anything that can enrich the foreigner, *who may one day become an enemy*; but who does the reviewer expect to be able to convert to so detestable a doctrine? Certainly the working classes will not be won over to so unchristian a policy; the fact being, that it is questionable how far *any* war would be supported by the sympathies of the working classes, either in this or other countries. Their hard earnings are only squandered in such contests, without producing the least amelioration of their condition; and if, for the future, the aristocrat classes choose to go to war, they must be prepared to bear the expense. Besides, if we enrich the foreigner by an exchange of commodities, do not we enrich ourselves also by the operation? Is a shoemaker or weaver to be hindered from making exchanges with the producers of other commodities, merely that he may keep those persons poor, and is he not keeping himself also poor by the same suicidal restriction? The exchange of commodities between nations or individuals is a mutual benefit and necessity; and we shall certainly not volunteer to forego the benefits incidental to such an arrangement to gratify the selfishness of an unscrupulous aristocracy. With foreign nations the industrial classes have no quarrel, and they know, moreover, that powerful as England is, the world can go on without her, and *will* do so, if she, like China, cut herself off from free intercourse, by a wall of impenetrable restrictions. If foreign nations be denied our manufactures, they will, of course, manufacture for themselves, or for one another; and we shall have the mortification of seeing our best customers going past our doors.

The monopolists seem to be sensible that the voice of the artizan classes must exert a powerful influence in the present struggle; and they seem to calculate on the support of the persons engaged in the small trades, which are afflicted with the benefits of protection. The solicitude professed for the well-being of these persons is not very easily explicable on any hypothesis of philanthrophy,—for no such sympathy has been manifested when artizans have been thrown out of employment by the introduction of machinery, or any other innovation, by which they have been the only sufferers: nevertheless we must not suffer our doubts of the sincerity of these new converts to the rights of industry to diminish the weight of any arguments they may bring with them. The following are the remarks of the *Quarterly Review* upon this topic:—

Let us look a little at the practical operation of *this principle* on other interests. If there is to be free trade in corn, there must be a *à fortiori* in every thing. Now let us see. All British manufactures are protected by duties varying from 10 to 20—and in a few cases 25—per cent. on the value; —and we ask the watchmakers, shoemakers, glovemakers, silk-weavers, and riband-weavers, whether they think they can meet foreign competition if that protection under which they have grown to their present state, shall be removed. The duties on rum and brandy are protective of British spirits by the difference of duty between them. Barley-growers would be delighted, no donbt, at the removal of the malt duties, but if the removal of the malt duties is to be accompanied by the free importation of foreign barley, wines and spirits, where will be the barley-growers? Norfolk and Suffolk will become what protecting duties have reclaimed them from—sandy wastes! Nor must we forget our own craft. If the protection against foreign reprint of our books is to be removed, what will become of popular authors, of publishers, of master printers, and journeymen printers?

Now we think that this argument admits of a very simple reply. If we import French ribbons or hardware, we must pay for them in our own manufactures, so that the real question is not whether we shall encourage the French or British artizan, but whether we will encourage the British artizan who does work badly at the expense of one who does it well. The total number of working men employed in this country must be quite as great, or rather very much greater under the system of free trade, than under the system of protection; but the distributiou of labour will be different, and every one will then produce, what he can produce with most advantage. If we make less silk we will make more calico; and we shall make more cutlery if we made less *bijouterie;* for our imports must be purchased with our manufactures, as we have no other source of wealth with which they can be bought. It is no doubt a fact that the disarrangements incidental to so many changes of occupation must occasion great inconvenience to a considerable part of the working population; yet this surely cannot be a reason why the present vicious system should continue for ever. The periodical fits of depression brought upon trade by the protective system are far more mischievous even to protected trades than the removal of all protection can possibly be; and whatever men may be thrown out of work by the break up of the system of protection, will soon be absorbed by other analogous occupations, in which an immediate demand must spring up for their services. The duties on rum and brandy, on malt, foreign wines, and numerous other things, may all benefit particular persons if viewed apart from the protection that has been conceded to other interests; but there is a manifest injustice inflicted by any scheme of protection which does not protect all interests equally; and to suppose that we could be benefited by such a system is just about as reasonable as to suppose that we may all become rich by robbing one another.

But Norfolk and Suffolk will become the sandy wastes they were before, says the *Quarterly*, if protection be withdrawn. So let them. We can discern no advantage in cultivatiug the sea-shore, or any other sandy waste, when there are thousands of acres of fertile land in surrounding countries ready to yield a grateful return for the labour expended upon them; and if sandy wastes be cultivated for the future, it must not be with funds derived from the plunder of the people. As regards the publications the *Quarterly* refers to, there can be no objection to the admissiou of foreign re-prints in this country provided they be not piratical, and that the law of copy-right has been respected; if foreign printers can work better and cheaper than English printers, it is right that they should have the preference. The work we give to foreigners to do will bring us an equal amount of work in some other department of industry in which we have the advantage; while the public will be manifest gainers by any arrangement which supplies them with better articles at a lower price.

It is maintained by some of the advocates of monopoly, that if protection be abolished, wages will fall; and that the working classes will be reduced to the miserable condition of the labourers of Poland, and other countries, in which corn is abundant. It would appear to be the hypothesis of these persons, that abundance of corn is a misfortune; whereas working men perceive that Poland and the other places referred to are miserable in spite and not in consequence of the abundance scattered around them. No one thinks of attributing the misery of Sutherland to its large supplies of fish; or the wretched condition of the natives of Guinea to their possession of ivory and gold. America has cheap corn as well as Poland, yet the working classes in America have many more comforts than the working classes both in Poland and in England, for they have cheap food and high wages, while pauperism is nearly unknown. We believe that a diminution in the price of food would eventually lower wages if unaccompanied by increased production; but inasmuch as corn would not be imported except more was given for the same quantity of industry by the foreign than by the home grower, the decline in wages would not be commensurate with the fall in the price of food. But as the effect of free trade must be to increase production—for we shall not only have to manufacture for the agriculturist we employ abroad, but for the artizans who manufacture for them—aud as the rate of wages in any occupation depends chiefly ou the velocity with which it extends, we believe the first effect of free trade must be to raise wages. By increasing the number of our markets too, it will diminish the chance of sudden fluctuation. We are now at the mercy of the seasons; for a bad harvest, by raising the price of food, leaves less to be spent upon manufactures; so that famine and want of work invariably come together: whereas free trade, by increasing the number of channels in which our manufactures circulate, and the number of sources from whence we derive our supplies of corn, will cause prosperity to flow on with a smooth and even current, instead of a succession of deluges and droughts.

Such then are a few of the considerations we should be disposed to offer on behalf of the working classes, in answer to the *Quarterly Review* and the other champion of protection. The reviewer speaks like a man *in extremis;* supplicates and apostrophises; sets *italics* and notes of exclamation in imposing array; but after all appears unable to listen to his own consolations. He appears to be half conscious that he is on the wrong side, and the truth is, his arguments are but transparent sophisms that the sun shines through. He would coop us up in a pen, and endeavour to reconcile us to starvation, and then strive to mystify and bamboozle us, and hinder us from discerning the iniquity. Working men well know that the policy of the money classes has hitherto been to press down the industrious classes to the greatest possible degredation consistent with their own safety; but this policy is daily becoming more dangerous, and unless relinquished will bring a terrible retribution. Every one now understands that gluts and distress in the manufacturing districts arise from the production of manufactured articles having exceeded the production of food; and that all, who would be damaged by the contraction of the volume of our industry to the size answerable to such an island as Guernsey, must be proportionately benefited by its enlargement. Who would dare, ask the *Quarterly*, to render useless or valueless the *plant* or works that have been called into existence by the system of protection? Everybody—anybody; for those works are not and never have been wanted. If the land-owners by superior force, compelled the public to tolerate the present system, they cannot be surprised if that toleration be brought to a close so soon as compulsion can no longer be practised. We are asked whether we should wish to have free trade in labour? We have it already. Who was it but these protectionists who during the tailors' strike instigated the importation of German tailors, wheu members of parliament and other high personages declared that they would sooner go naked than consent to the cession of the tailors' demands? They were free traders then—we will be free traders now; not from any vindictive spirit, but because we sincerely believe it to be the most beneficial policy for all parties. We have out-grown our prejudices, and would recommend the aristocracy to out-grow theirs as speedily as they can. The present movement they may direct, but cannot resist. If they prolong the contest, rents will go as well as protection—the working classes will be knit to the manufacturers by a common object of endeavour, and a league far more powerful than the present one will be formed that will rule the aristocracy with a rod of iron, and will probably extinguish it altogether.

These dangers are, we believe, discerned clearly enough by Sir Robert Peel, and the more sagacious members of his party; and how are they to be averted? First, by the prompt concession of free trade; and secondly, by forming an alliance with the working classes. Landlords, instead of letting out their farms to individual tenants, should throw a number of farms into a joint stock company, bringing sufficient capital, by the issue of shares, to work it well, and make every workman employed a participator in the profits realized. Factories might be started on the same principle, which would be sure to draw the best workmen to them; and by the adoption of this expedient, the owners of land would not only secure an undiminished income, but would by an identification of interests tie the working classes effectually to them. The benefits of this system are set forth at some length in a late number of the "People's Journal," and we may here transcribe some of the remarks there given:—

The managers of factories are generally made participators in the profits realised, and the most beneficial results have sprung from the arrangement; but the principle has not been generally extended to the workmen, though recent experiments show that, in their case, it might be applied with equal advantage. M. Leclaire, a house-painter, in Paris, has for some years made his workmen participators in the profits of his establishment—and, in a pamphlet recently published, he speaks of the system in the highest terms of praise. Lord Wallscourt has long pursued a similar plan in the cultivation of his estates in Ireland, and its operation has been such as to stimulate the supine Irish peasant into active industry, and to shed prosperity and gladness over a district that was formerly the abode of famine and despair. In reply to our inquiries, Lord Wallscourt says:—"I have tried the plan for seventeen years, and have found it to answer much beyond my hopes; inasmuch as it completely identifies the workmen with the success of the farm, besides giving me full liberty to travel on the continent, for a year at a time, and, upon my return, I have always found that the farm had prospered more than when I was present."

Lord Wallscourt's practice is to reckon every workman as the invester of as much capital as will yield at five per cent. per annum, the sum paid to him in wages. In a factory conducted on this principle, the capital requisite for the erection of the necessary works, and for carrying the business on, would be regarded in the light of a debenture, upon which a sufficient rate of interest to cover the risks would have to be paid, before any profits could be divisible among the workmen; but a certain rate of wages would be secured to the workmen as a minimum, whether there were profits or not. The profits might be divided every year, and, to avoid a partnership transaction, might be distributed as gifts instead of profits, whereby too, any workman discharged for misconduct would have no further claim upon the establishment. This is the plan pursued both by Lord Wallscourt and M. Leclaire, and we have their testimony to show that it is in every respect satisfactory.

It is clear that the principle of a fair division of profits satisfies every aspiration of industry, while it aids the progress of humanity to that higher condition which concurring events proclaim to be its destiny. Machinery, instead of being the competitor of the working man for subsistence, will, so soon as this great principle gains an effectual introduction, be his assiduous slave, and will work for him more precious enchantments than those attributed to the obedient genii of fairy tales. If machinery ploughs, or spins, or toils in the mine, it is for the working man that it will perform these beneficent labours; and whatever benefit the introduction of machinery brings, he will participate in it in a fair proportion. Every intellectual capacity will be brought into increased exercise, and men will not require to labour so much when they gain some voice in the disposition of their labour, as the vehemence of competition between rival factories will be thereby arrested. We own we think that even six hours of work in the day would be enough; for with good machinery, efficient direction, and such activity as must arise when men are made participators in the profits arising from their labours, as much work may be done in six hours as in ten or twelve hours, according to the present system. "To this complexion we must come at last;" for men will not for ever be willing to consider themselves as mere instruments of production: they are already beginning to understand that they are men as well as workmen; that they have minds to be enlightened—hearts to be exalted, and souls to be saved; and that the existing hours of labour are such as to prohibit the due cultivation of any of the talents with which they have been entrusted by Providence. Public walks and baths, mechanics' institutions, and the other means of recreation and improvement provided for the industrious classes, must all signify nothing so long as there is no time available to enjoy their advantages; but the abbreviation of the hours of labour would flow naturally from the system of a division of profits, as workmen would then have influence enough in the management of manufactories to gain the repeal of any obnoxious regulation.

It appears to us that the turn which the application of this principle happens to take, must determine the fate of the aristocracy; for with whatever party the working classes connect themselves, they will make that party irresistible. Many working men are, it must be acknowledged, distrustful of the League; and if the aristocracy, instead of investing money in land or in railways, were to invest it in joint-stock manufactories, worked on the principle of a division of profits, they would not only be insuring a beneficial employment for their capital, but would entrench themselves in a political strong-hold from which no power probably could ever drive them. If, however, the aristocracy is wise only when it is too late; if it lots the present opportunity slip. and suffers employers and employed to adjust their differences as they show an increasing disposition to do, and to enter into a new compact by which ancient breaches are healed, and they are bound together by an identification of interests for the time to come; it needs no great perspicacity to see, that the power of the aristocracy must receive a shock from which it will never recover while the democratic element rushes irresistibly onward; until all ancient land-marks are submerged or swept off by the swelling flood.

## ART. II.—FALL OF A BRIDGE ON SOUTH-EASTERN RAILWAY.

THE various accidents which have occurred upon our Railways have seldom hitherto arisen from failures of the line itself, but from the derangement or mismanagement of the locomotives, or a defective system of signals. An unfortunate accident has however recently occurred on the South-Eastern Railway from the failure of a bridge, which has been attended with fatal consequences.

The scene of this accident was about one and a half miles from Tunbridge, in the valley of the Medway, the waters of which are much increased by heavy rains at this season, and often inundate a great extent of adjacent level land. The Railway traverses this valley on an embankment eighteen or twenty feet high, which is perforated with bridges, termed Occupation-bridges, through which the communication between farms on opposite sides is maintained. The Medway runs along the north side of the line, at the place of the accident, where a branch, which diverges from it at Penshurst, crosses under the Railway and rejoins the *main* stream. About four hundred yards from this place was the Occupation-bridge which has given way. The main body of the stream being on the north side of the line, the fields on that side are the first to suffer from the rise of the water, which on the night of the accident was so great as to reach the embankment and pour through the Occupation-bridge, where it was for a short time impeded by a brick wall thrown up by the contractors to protect a large ballast quarry from its inroads. This slight defence was soon broken down and the water rushed freely into the ballast field. The south branch of the stream had by this time become so full that its banks also were overflowed, and this new flood encountering that from the parent stream at the corner of the ballast field, a most destructive eddy was occasioned, which undermined the embankments and the brick abutments of the bridge. These injuries were received during the night, for the previous train, which left Tunbridge at half-past seven o'clock on the preceding evening, passed the bridge in safety. The luggage train, however, which left Tunbridge at a quarter to one o'clock on the morning of Tuesday, the 20th, was less fortunate, for on arriving at the Occupation-bridge it gave way, and the engine and tender, with some of the luggage vans, were thrown into the chasm, and the rest of the train was instantaneously stopped. The engineer, in attempting, as it is thought, to leap from the falling carriages, was caught between the engine and tender, and so dreadfully lacerated that he scarcely survived his removal to Tunbridge; his brother, who was stoker, escaped without any very dangerous injury. Measures were immediately taken to restore the communication between the different sides of the bridge, by making a temporary timber bridge for passengers, who were received by trains at either side, and very speedily one side of the line was restored sufficiently to admit of the uninterrupted passage of the trains. It is fortunate that the immersed carriages were only filled with goods, instead of passengers, otherwise the consequences might have been much more serious.

The Occupation-bridges on this part of the line are formed of iron girders, laid upon brick piers, which do not seem to have been calculated to resist the violence of the periodic floods which occur in the neighbourhood. Provision against dangers of such regular recurrence is an essential part of an engineer's duty, and the absence of precautions argues either want of foresight or reprehensible negligence.

## ART. III.—COAL-PIT EXPLOSIONS.

A LAMENTABLE explosion of a coal-mine has just occurred near Newport, in Monmouthshire, by which thirty-five persons have lost their lives. It is now three years since we expressed our conviction of the necessity of some step being taken by Government to obviate these disasters; but although scientific men have been appointed to make reports upon the subject, no practical measures of precaution have yet been adopted. The cause of this apathy is, we suppose, traceable to the fact that miners are poor men, and their lives are consequently valueless. If a few dukes were to be blown up, instead of a host of industrious miners, we should soon have laws enough upon the subject, and legislative wisdom, whether hereditary or elective, would all be up in arms; but what can the annual martyrdom of a few hundred miners signify when demanded by dukes and marquesses, and other coalowners, as the condition of saving to them the expense of ventilation? It has been repeatedly shown, by the most competent authorities, that by the introduction of efficient ventilation, explosions may be altogether prevented, but mine-owners will not take any step towards such ameliorations until forced to do so by Government; and Government shows but little disposition to resort to such coercion. Thus the miner suffers: he is taught to have recourse to his own powers of coercion, such as they are, and both political and social disaffection are widely sown.

The colliery in which the present accident occurred is one belonging to Mr. John Russell, and is known as the scene of former similar disasters. The substance of the following particulars is given by a correspondent of the *Times*:—

"The first thing that attracted my attention was the village churchyard, which had more the appearance of a ploughed field than anything else. Around the graves were grouped the relatives and friends of the victims. Proceeding to the pit I had an interview with the engineer, who has supplied me with the following detail:—On Wednesday morning, about 120 men and boys descended the pit—which has two main headings, with several cross headings—and proceeded in batches to their assigned branches. They were not provided, as far as I have been able to discover, with Davy's lamp, but had common candles or open lamps. This appears to be the more extraordinary from the numerous explosions which from time to time have occurred in the same colliery, and in every instance attended with loss of life. Whether, in permitting this, any reckless risk was run, must be judged of by your readers, but the impression very general here is, that the thing was highly censurable. The first indication which the people at the mouth of the pit had of the explosion was a strong rush of carburetted hydrogen at the top, accompanied by a slight noise, and it was at once understood that the fire-damp had come into contact with a light, and all the fearful consequences of such a calamity were at once made but too apparent. After a little time twelve gallant fellows volunteered to go down in search of their hapless comrades. It was a considerable time before anything could be done, owing to the sulphureous impregnation of the air; but they were at last able to commence a search. The first body found was that of a boy, eleven years old, who, when the explosion occurred, must have run about 300 yards, but was of course overtaken by the current of exploded gases, and suffocated. The poor little fellow's cap was found thrust into his mouth, as if he had made a desperate effort to exclude the poisonous air. Shortly after, five other bodies were recovered, and regular relays of searchers having been provided, the search was vigorously proceeded with, and, as I stated before, twenty-eight bodies have, up to this moment, been brought out. Around the mouth of this fearful pit are standing the wretched widows and orphans of the sufferers, and as the tram reaches the top, at intervals of three minutes, how anxiously are their eyes directed to it, in miserable expectation of viewing the body of a husband or a father.

"I cannot refrain from offering an observation or two upon the great neglect of duty which the Legislature has evinced with regard to coal-mine explosions. It is a matter of painful knowledge to all who take the trouble of observing it, that year after year hundreds of the unfortunate of both sexes, and of all ages, are sacrificed in coal-mines, to the criminal negligence, and, what is much worse, the guilty cupidity of coal-proprietors. In too many instances the simplest precautions are not taken for the prevention of accident, and more particularly it happens, that when the demand is greater than the supply, and that vessels are waiting under demurrage to be loaded, the work is proceeded with night and day, in contempt of every obligation of social duty, and heedless of the almost inevitable consequences of such rashness. The Legislature keeps a laudable watchfulness upon railways and steamboats, but the slaughter anuually committed in collieries is left to a passing newspaper report, and forgotten until a repetition of the calamity revives the remembrance of it. If the master of a steampacket causes the loss of even one life, his conduct is promptly aud rigidly investigated, and if circumstances warrant the presumption that he had been guilty of the slightest want of skill or departure from duty, an implicatory verdict is had against him. There is also the same just surveillance exercised over railways. Let an accident happen, and we find the whole country up about it, and public feeling does not subside until after a full and satisfactory investigation of the occurrence. If there are more lives lost in coal-mines than upon railways—and the fact is distressingly true—why should not the same means be adopted for developing the causes of accident, and where guilt lies, for the punishment of it? Why does not the strong arm of the law interpose to prevent the appalling sacrifice of human life which from one year's end to the other takes place in the coal-mines of England? The present I hold to be a good opportunity for a commencement, and I sincerely hope that the Government may feel itself called upon to be represented at the adjourned meeting of the inquisition by a special officer, who would take care to sift the matter to the bottom."

In this recommendation we fully concur. A man convicted of culpable homicide by causing the death even of one man is visited justly with the severest penalties. Shall we then connive at the perpetuation of a system which periodically slays its thousands?

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## Art. IV.—SANATORY CONDITION OF THE PEOPLE.

In the social and political, as in the physical economy, there are certain laws which compel obedience by the sanction of heavy penalties inflicted upon those who slight them. These ordinances of high heaven may, it is true, be despised or neglected for a while with impunity, but a retribution is certain which derives from delay an additional severity. Offences against these statutes, however they may be designated, are all similarly redressed, and it is one pervading feature of those re-adjustments, that every offence necessarily involves its own punishment—the cherished sin becomes the unrelenting avenger. When these transgressions are chargeable upon individuals they are generally expiated in their proper persons, but in social offences the evil takes deeper root and requires time to develope its malignity. Since the days of the first murderer it has been a prevailing vice to pursue a cruel, selfish, and overbearing policy towards those classes which are from their ignorance or poverty incapable of effectual resistance against aggression; aud when the cry of their misery has gone up to heaven, the proud and unfeeling defence has always breathed the same spirit of selfish independence as that of the bold fratricide.

This spirit enters pretty largely into the purely commercial relations which subsist between the different classes of society; and which, aided by the *material* construction of the laws of political economy, have obtained to a deplorable and alarming extent. One manifestation of the carelessness of the comfort and happiness of others is seen in the neglected condition of the poor of our crowded districts, who have been left to sink deeper and deeper in misery and degradation. This condition, however, it is found can no longer be continued, and for a reason that will touch the hearts of the most obdurate, and unlock the coffers of the most grasping. It is found that it is more costly to permit the existence of wretchedness, than to take measures for its removal and prevention; in short, that the selfish neglect of our poorer bretheren, entails a punishment which would be cheaply averted at almost any cost. It is lamentable to think that such sordid motives should require to be appealed to, when the higher and better feelings ought to be sufficiently influential, yet it is a happy circumstance, that selfishness should find its full development checked by the operation of its own intrinsic result, and that a guarantee is thus given for the retention of that principle within its proper limits.

The public attention has been much given to the disclosures which have lately been made of the sanatary condition of the people of this country, and great praise is due for the able and judicious reports of the commission appointed to inquire into that subject. The information they elicited from the best sources throughout the kingdom, has been such as to surprise and distress even those who considered themselves previously well acquainted with the subject; and there can be little doubt that the recommendations which they have submitted to the throne, will be carefully considered with a view to their practical aud speedy adoption.

The chief diseases which prevail among the people are attributable to causes which easily admit of the application of remedial measures, which are only delayed by the ignorance that exists respecting the extent of the evils and the best means of eradicating them; or the cupidity of some who blindly imagine they have a direct interest in the perpetuation of misery and disease. The principal causes of disease are defective drainage and sewerage, the want of a sufficient supply of water, the absence of a good system of ventilation, the crowded condition of the lower class of dwellings, and the want of the ordinary aids to cleanliness; the injurious emanations from exposed animal and vegetable refuse, from manufactories, and from places of interment.

The evils arising from an insufficient ventilation are very obvious in the cases of those trades in which it is the custom for large numbers to work together. In these it has been found that there is a prevalence of consumptive and scrofulous affections, while those occupations which admit of a better supply of pure air are comparatively exempt. We seldom hear of such complaints amoug out-door workmen, and we are disposed to attribute the healthy and ruddy appearance of butchers to the construction of their shops, which do little more than protect their inmates from the rain.

The most influential cause of mortality is the poisonous miasma which emanates from cesspools, or from exposed accumulations of decaying organic matter. The effect of these in producing malignant fevers, has been abundantly proved by the evidence of experienced medical men, and by the results of improvements in afflicted districts, which have always been followed by a diminution of disease and death. A very striking example of this was given in a district of Manchester, where the removal of refuse, and improved draining and paving, were rewarded by a diminution of the mortality to the extent of eighteen per cent. The diseases arising from these pestilential exhalations are not wholly confined to the lower classes, amongst whom they originate, but they extend their ravages to the middle and wealthier classes, who are thus made to suffer along with the victims of their neglect. In a uational poiut of view, much loss is experienced from the operation of these maladies, for although uo age is exempted from them, the majority of those carried off by them are persons between the ages of twenty and thirty, the very time when they have young families depending upon them. Even when disease does not terminate fatally, there is a large expenditure of means both during the illness and the subsequent recovery, the burden of which, in some way or other, must fall upon the community. Besides this immediate loss, the population is permanently debilitated by the continuance of the exciting cause of disease, and becomes prematurely helpless and superannuated, with an enfeebled offspring treading the same round of miseries—falling an easier prey to the same ills. The influence of these adverse circumstauces is not confined to the physical condition of the poor; living in a pestilential atmosphere, surrounded by misery and disease, they are driven as a last sad refuge to the excitement and momentary oblivion of intemperance, which too often is but the prelude to the further degradation of crime.

The present legislative enactments respecting drainage provide drains for carrying off surface water, but they cannot be used to remove refuse from houses without manifest injury to health from the noxious effluvia which they emit. There is no power to compel the cleansing of these drains, a duty, therefore, frequently neglected. The surveyors are liable to be superseded at the end of every year; and these frequent changes are very adverse to any well-considered and systematic improvements, by which real and permanent benefit can alone be realized. These defects exist in towns which have recently risen from the class of villages; but even in towns which have obtained local acts, drainage is either overlooked altogether, or is only provided for part of the town. In some towns the charge of works for sauatory purposes is vested in various distinct and indepeudent bodies, whose powers are frequently inconsistent. Thus, at Liverpool, the paving and sewering are kept separate from the cleansing of the streets, and this in turn is distinct from the duty of draining and cleansing courts and alleys. It is highly desirable that there should be accurate plans of districts which it is intended to drain, and the system of contour maps is very useful, as it shows at a glance the aspect of the ground, with its relative levels and declivities, and facilitates the selection of the best line of drainages. The neglect of such a selection has, in some instances, occasioned great loss, by compelling the reconstruction of sewers which had been injudiciously planned. It has been suggested that the ordnance surveyors should extend their labours to the making such surveys of towns, which, especially in the districts not yet completed by them, might be done at a small expense. If such surveys were made, it would facilitate the definition of the natural area of drainage, at present part only being under any control, or there being separate jurisdictions, so that, in the event of the extension of a town the suburbs long remain undrained, or one board prevents an other from making use of the natural outfall of the drainage.

There is much injury experienced in some districts from the erection of weirs on rivers, which are thereby converted into great cesspools; and in new streets there is no drainage or paving until a certain proportion of buildings in the streets has been completed, and then much in convenience and interruption of business is occasioned by the construction of the sewers. In most towns cesspools and dung-heaps, slaughter-houses and pig-styes, smoke, and noxious fumes from factories, are too frequenfly found contaminating the air. In some places the property of all refuse is vested in the authorities, who dispose of it on such favourable terms as almost, or entirely, to repay the cost of frequent removal. The narrow courts and alleys of towns are attended by other evils beside insufficient drainage and cleansing; they are generally so narrow, and the houses so high, that they are not supplied with a current of pure air, and the privation is aggravated by the houses in them being unadapted for ventilation, especially in the case of lodging-houses, in which way-farers are huddled together in confined chambers. In many schools, children are retained for hours in a vitiated atmosphere wihout respite or recreation. The absence of a cheap and constant supply of water to the dwellings of the poor, is a great obstacle to the promotion of cleanliness, which would be further encouraged by the establishment of baths and wash-houses. Most of the preceding remarks apply with equal force to the metropolis; there are the same defects in the constitutions of the numerous and conflicting boards, the same imperfect supply and inferior quality of water. The greater part of the water is brought into town in open ditches, which are made the receptacles of every species of filth by the inhabitants along their banks; the public wells would in some measure compensate for the deficiency of water, but they also are in too many cases polluted by the noxious infiltrations of sewers and burying grounds. The apathy which has long existed respecting the sanatory condition of the poor seems to be gradually wearing out and we are happy to see the promise of vast amelioration, which will give to its promoters solid and lasting benefits, as well as the reward of a satisfied conscience, and the gratitude of a regenerated people.

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## ART. V.—HOW TO CONSTRUCT A STAIRCASE IN AN OCTAGONAL TOWER.

THE following example of a staircase is one which was actually crected in the octagonal tower of a lodge, and the method detailed is that which was adopted in its construction; and although it is neither a very difficult nor a very beautiful specimen, it may prove of service to some of our readers in elucidating the principles of their art.

Fig. 1.

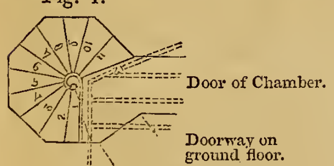



Fig. 2.

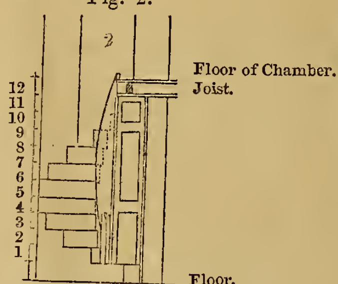
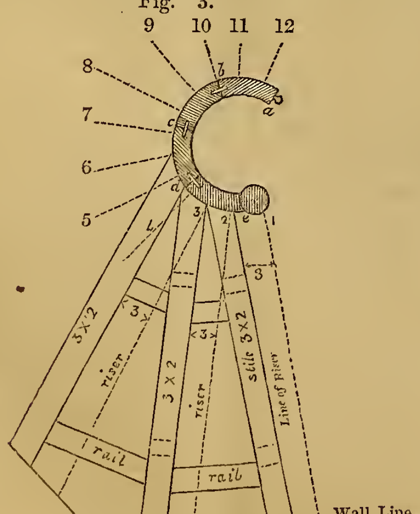



*Fig.* 1. is a plan of the tower and staircase, and *fig.* 2. is an elevation.

Fig. 3.

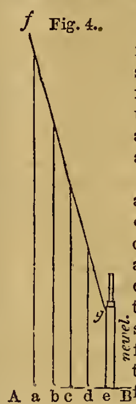



$\frac{3}{4}$ of au inch = 1 foot;

*Fig.* 3. shows the carriages framed under the winders; the stairs consist of $\frac{5}{8}$ inch risers, tongued and glued into 1 inch treads, with rounded nosings, and housed into a $1\frac{1}{2}$ inch circular string-board, or hollow cylinder, glued upright, and reaching the floor, which we will call a spandril; 1 inch $\times$ $\frac{3}{4}$ inch bar ballusters, and $2\frac{1}{2}$ inch $\times$ $1\frac{1}{2}$ inch birch oval handrail; one edge of the spandril is rebated and beaded to receive a door and frame, which shut up a coal place under the stairs, and the upper end is hollow moulded in lieu of a capping.

To procure the size of the staves for glueing up the spandril, stick nails in the points *a, b, c, d, e,* on the plan at *fig.* 3 : bend a thin slip of wood round these, marking the situation of each joint upon it as *a, b, c, d, e, fig.* 4.;

Fig. 4.




set these out on a straight line A B, *fig.* 4; draw lines perpendicular to this from the points *a, b, c. d, e,* which represent the joints; make *a* equal to the height of twelve steps, and *c* equal to the height of two steps; allow sufficient for the spandril to stand above the steps and for squaring it up; draw a line from *f* to *g* which gives the proper length and bevil of each stave; then cut them out of each other so as to save wood.

Frame the carriages as shown at *fig.* 3, keeping the front stile about 3 inches from the face of the riser to allow for blocks, &c., number each, and mark the wall line and back of spandril on them; glue and wedge the puncheons into the front stiles; and, having previously slit the lower tenons, guage the shoulders from the upper side of the front stile, making it equal to the height of a step; this saves the labour of gauging the stiles to a parallel width; the puncheons of the first step are framed into an oak sill. The carriages being thus prepared at the bench are wedged firmly in the wall, beginning with the first step, and strutted beneath between the back stiles; the steps are blocked to them. In all cases where stairs have framed carriages, they should be fixed as soon as the building is covered in, to prove their firmness by the labourers carrying up plaster.

Having glued up the spandril in staves as directed, make the inside to fit a template of the plan of the well hole, and gauge it to the proper thickness. Plane the longest edge straight; and square and cut the lower end, so that when placed on a level surface, it will stand perpendicular. To do this, cut the end of a strong sheet of paper, perpendicular to one of its edges, place the edge of this fair with the straight edge of the spandril; and bending it round the outer surface of the latter, mark the end of the paper upon it; having cut the spandril to this line, place it on the plan of the stairs, and mark the situation of each riser upon the lower end of it; again apply the paper, and transfer the riser lines upon it, as marked on the spandril; this gives the cxact development of the steps : bend the paper again round the spandril, towards the upper end, and draw lines on the latter, from the marks on the lower end of it to those on the paper; upon these set out the heights of the various steps, by means of the height rod, keeping the end of the latter fair with the lower end of the spandril, and house the steps into it in the same way as for the string-board of a common newel staircase; the treads are marked and cut to their proper shape as set out on a drawing board full size, as for the winders of a common newel staircase, and the steps glued up in the same way.

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## ART. VI.—A CATECHISM OF THE STEAM-ENGINE.

1. What is meant by a vacuum ?—A vacuum means an empty space; a space in which there is neither water nor air, nor anything else that we know of.

2. Wherein does a high-pressure differ from a low-pressure engine ?—In a high-pressure engine the steam, after having pushed the piston to the cnd of the stroke, escapes into the atmosphere, and the impelling force is thercfore that due to thc difference between the pressure of the steam, and the pressure of the atmosphere. In the condensing engine the steam after having pressed the piston to the end of the stroke, passes into the condenser, in which a vacuum is maintained, and the impelling force is that due to the difference between the pressure of the steam, and the pressure within the vacuum, which is nothing; or, in other words, you have then the whole pressure of the steam urging the piston, consisting of the pressure shewn by the safety valve of the boiler, and the pressure of the atmosphere besides.

3. How can the pressure of the vacuum be said to be nothing, when the existence of a vacuum occasions a pressure of 15lbs on the square inch ?—Because it is not the vacuum which exercises this pressure, but the atmosphere, which, like a head of water presses on everything immerged beneath it. A head of water however would not press down a piston if the water were admitted on both of its sides, for an cquilibrium is then established, just as a balance retains its equilibrium though an equal weight be added to each scale; but take the weight out of one scale, or empty the water from one side of the piston, and motion or pressure is produced; and in like manner pressure is produced on a piston by admitting steam or air upon the one side, and withdrawing the steam or air from the other side. It is not therefore to a vacuum, but rather to the existence of an unbalanced plenum, that the pressure made manifest by exhaustion is due, and every one knows that a vacuum of itself would not work an engine.

4. How is the vacuum maintained in a condensing engine?—The steam, after having performed its office in the cylinder, is permitted to pass into a vessel called a condenser, where a shower of cold water is discharged upon it. The steam is condensed by the cold water, and falls in the form of water to the bottom of the condenser. The water, which would else be accumulated in the condenser, is continually being pumped out by a pump worked by the engine.

5. If a vacuum be an empty space, and there be water in the condenser, how can there be a vacuum there?—There is a vacuum above the water, the water being only like so much iron or lead lying at the bottom.

6. Is the vacuum in the condenser a perfect vacuum?—Not quite perfect, for the cold water entering for the purpose of condensation is heated by the steam, and emits a vapour of a tension represented by about three inches of mercury; that is, when the common barometer stands at 30 inches, a barometer with the space above the mercury communicating with the condenser will stand at about 27 inches.

7. Is a barometer sometimes applied to the condensers of steam-engines?—Yes; and it is called the vacuum gauge, because it shows the degree of perfection the vacuum has attained. Another gauge, called the steam-guage, is applied to the boiler, which indicates the pressure of the steam by the height to which the steam forces mercury up a tube.

8. Can a condensing engine be worked with a pressure less than that of the atmosphere?—Yes, if once it be started; but it will be a difficult thing to start an engine, if the pressure of the steam be not greater than that of the atmosphere. Before an engine can be started it has to be blown through with steam to displace the air within it, and this cannot be effectually done if the pressure of the steam be very low. After the engine is started, however, the pressure in the boiler may be lowered, if the engine be lightly loaded, until there is a partial vacuum in the boiler. Such a practice, however, is not to be commended, as the gauge-cocks, which are cocks applied for telling the height of water within the boiler, become useless: but though opened water will not rush out, air will rush in, and it is impossible also under such circumstances to blow out any of the sediment collected inside. In some cases, in which the boiler applied to an engine is of inadequate size, the pressure within the boiler will fall spontaneously to a point considerably beneath that of the atmosphere; but it is preferable in such cases partially to close the throttle-valve in the steam-pipe, whereby the pressure in the boiler is maintained, though the cylinder only receives its former supply.

9. In what way would you class the various kinds of condensing engines?—Into single acting, rotative, and rotatory engines. Single-acting engines are engines without a crank, such as are used for pumping water. Rotative engines are engines provided with a crank, and in this important class stand marine and mill engines, and all engines, indeed, in which rectilinear motion of the piston is changed into a circular motion. In rotatory engines the steam acts at once in the production of circular motion, either upon a revolving piston or otherwise, but without the use of any intermediate mechanism such as the crank, for deriving a circular from a rectilinear motion. Rotatory engines have not hitherto been successful, so that only the single-acting or pumping engine, and the double-acting or rotative engine, can be said to be in actual operation.

10. Is not the circular motion derived from a cylinder engine very irregular, in consequence of the unequal leverage of the crank at the different parts of its revolutions?—No; rotative engines are always provided with a fly-wheel to correct such irregularities by its momentum, unless two engines with their respective cranks set at right angles are employed, and then the irregularity of one engine corrects that of the other.

11. Is there no difference between single-acting and double-acting engines except in the use of the crank?—Yes; single-acting engines act only in one way by the force of the steam, and are returned by a counterweight, whereas double-acting engines are urged by the steam in both directions. Pumping engines might easily be made double-acting though unprovided with a crank; there would be no difficulty in so arranging the valves as to admit of this action, for the pumps might be contrived to raise water both by the upward and downward stroke, as indeed in some mines is already done. But engines without a crank are almost always made single-acting—perhaps from the effect of custom, as much as from any other reason.

12. With what velocity does air rush into a vacuum?—With the velocity which a body would acquire by falling from the height of a homogeneous atmosphere. The weight of air being known, as well as the pressure it exerts on the earth's surface, it becomes easy to tell what height a column of air, an inch square, and of the atmospheric density, would require to be, to weigh 15lbs. The height would be 27,818 feet.

13. And what velocity would the fall of a body from such a height produce?—About 1,338 feet per second. All bodies fall with the same velocity, when there is no resistance from the atmosphere, as is shown by the experiment of letting fall a feather and a guinea from the top of a tall exhausted receiver, where they reach the bottom at the same time. The velocity of falling bodies is one that is accelerated uniformly, according to a known law; and when the height from which a body falls is given, the velocity acquired at the end of the descent can be easily computed. The square root of the height multiplied by 8,021 will give the velocity.

14. What do you understand by the centre of gravity of a body?—That point within it, in which the whole of the weight may be supposed to be concentrated, and which continually endeavours to gain the lowest possible position. A body hung in the centre of gravity will remain at rest in any position.

15. What do you understand by centrifugal and centripetal forces?—By centrifugal force, I understand the force with which a revolving body tends to fly from the centre; and by centripetal force, I understand any force which draws it to the centre, or counteracts the centrifugal tendency. In the conical pendulum, or steam-engine governor, which consists of two metal balls suspended on rods, hung from the end of a vertical revolving shaft, the centrifugal force is manifested by the divergence of the balls when the shaft is put into revolution; and the centripetal force, which in this instance is gravity, predominates so soon as the velocity is arrested, for the arms then collapse and hang by the side of the shaft.

16. What is meant by the centre of gyration?—The centre of gyration is that point in a revolving body in which the whole momentum may be conceived to be concentrated. If the ball of a governor were to be moved in a straight line, the momentum might be said to be concentrated at the centre of gravity of the ball; but inasmuch as, by its revolution round an axis, the part of the ball furthest removed from the axis moves quicker than the part nearest to it, the momentum cannot be supposed to be concentrated at the centre of gravity, but at a point further removed from the central shaft, and that point is what is called the centre of gyration.

17. What is the centre of oscillation?—The centre of oscillation is a point in a pendulum or any swinging body, such, that if all the matter of the body were to be collected into that point, the velocity of its vibration would remain unaffected. The centre of oscillation is always in a line passing through the centre of suspension and the centre of gravity.

18. By what circumstances is the velocity of vibration of a pendulous body determined?—By the length of the suspending rod only, or, more correctly, by the distance between the centre of suspension and the centre of oscillation. The size of the arc described does not signify, as the times of vibration will be the same, whether the arc be the fourth or the four hundredth of a circle, or at least they are nearly so, and would be so exactly, if the curve described were a portion of a cycloid. In the pendulums of clocks, therefore, a small arc is preferred, as there is, in that case, no sensible deviation from the cycloidal curve.

19. If then the length of a pendulum be given, can the number of vibrations, in a given time, be determined?—Yes, the time of vibration bears the same relation to the time in which a body would fall through a space, equal to half the length of the pendulum that the circumference of a circle bears to its diameter. The number of vibrations made in a given time by pendulums of different lengths is inversely as the square roots of their lengths.

20. What measures are there of the centrifugal force of bodies revolving in a circle?—The centrifugal force of bodies revolving in a circle increases as the diameter of the circle, if the number of revolutions remain the same. If there be two fly-wheels of the same weight, and making the same number of revolutions per minute, but the diameter of one double that of the other, the larger will have double the amount of centrifugal force. The centrifugal force of the same wheel, however, increases as the square of the velocity; so that if the velocity of a fly-wheel be doubled, it will have four times the amount of centrifugal force.

21. Can you give a rule for determining the centrifugal force of a body of a given weight, moving with a given velocity in a circle of a given diameter?—Yes. If the velocity in feet per second be divided by 4·01, the square of the quotient will be four times the height in feet from which a body must have fallen to have acquired that velocity. Divide this quadruple height by the diameter of the circle, and the quotient is the centrifugal force in terms of the weight of the body, so that multiplying the quotient by the actual weight of the body, we have the centrifugal force in pounds or tons. Another rule is to multiply the square of the number of revolutions per minute by the diameter of the circle in feet, and to divide the product by 5,870. The quotient is the centrifugal force in terms of the weight of the body.

22. Can you explain how it comes that the length of a pendulum determines the number of vibrations it makes in a given time?—Because the length of the pendulum determines the steepness of the circle in which the body moves, and it is obvious that a body will descend more rapidly over a steep inclined plane, or a steep arc of a circle, than over one in which there is but a slight inclination. The impelling force is gravity, and if the velocity due to the descent of a body through a given height be spread over a great horizontal distance, the speed of the body must be slow in proportion.

23. If the motions of a pendulum be dependent on the speed with which a body falls, then a certain ratio must subsist between the distance through which a body falls in a second, and the length of the second's pendulum?—And so there is. The length of the second's pendulum at the level of the sea in London is 39·1393 inches, and it is from the length of the second's pendulum that the space through which a body falls in a second has been determined. As the time in which a pendulum vibrates is to the time in which a heavy body falls through half the

length of the pendulum, as the circumference of a circle is to its diameter, and as the height through which a body falls is as the square of the time of falling, it is clear that the height through which a body will fall during the vibration of a pendulum is to half the length of the pendulum as the square of the circumference of a circle is to the square of its diameter, namely, as 9·8696 is to 1, or it is to the whole length of the pendulum as the half of this, namely, 4·9348 is to 1; and 4·9348 times 39·1393 inches is 16 and 1-12 feet very nearly, which is the space through which a body falls by gravity in a second.

24. Are the motions of the conical pendulum or governor reducible to the same laws which apply to the common pendulum?—Yes; the motion of the conical pendulum may be supposed to be compounded of the motions of two common pendulums vibrating at right angles to one another, and one revolution of a conical pendulum will be performed in the same time as two vibrations of a common pendulum of which the length is equal to the vertical height of the point of suspension above the plane of revolution of the balls. A steam-engine governor may, it is true, be driven round with any speed, but as the speed is increased the balls expand, and the height of the cone described by the arms is diminished until its vertical height is such that a pendulum of that length would perform two vibrations for every revolution of the governor. If, therefore, a certain expansion of the balls be desired, and a certain length be fixed upon for the arms so that the vertical height of the cone is fixed, then the speed of the governor must be such that it will make half the number of revolutions in a given time that a pendulum equal in length to the height of the cone would make vibrations. The rule is, multiply the square root of the height of the cone in inches by 0·31986, and the product will be the right time of revolution in seconds. If the number of revolutions and the length of the arms be fixed, and it is wanted to know what is the diameter of the circle described by the ball, you must divide the constant number 187·68 by the number of revolutions per minute, and the square of the quotient will be the vertical height in inches of the centre of suspension above the plane of the ball's revolution. Deduct the square of the vertical height in inches from the square of the length of the arm in inches, and twice the square root of the remainder is the diameter of the circle in which the centres of the balls revolve.

25. Cannot the operation of a governor be deduced merely from the consideration of centrifugal and centripetal forces?—It can, and by a very simple process. The horizontal distance of the arm from the spindle divided by the vertical height will give the amount of centripetal force, and the velocity of revolution requisite to produce an equivalent centrifugal force may be found, by multiplying the centripetal force of the ball in terms of its own weight by 70,440, and dividing the product by the diameter of the circle made by the centre of the ball in inches; the square root of the quotient is the number of revolutions per minute. By this rule you fix the length of the arms, and the diameter of the base of the cone, or, what is the same thing, the angle at which it is desired the arms shall revolve, and you then make the speed of revolution such, that the centrifugal force will keep the balls in the desired position.

26. Does not the weight of the balls affect the question?—Not in the least. Each ball may be supposed to be made up of a number of small balls, and each of these small balls will act for itself. Heavy balls attached to a governor are only requisite to overcome the friction of the throttle valve which shuts off the steam, and of the connexions thereto. Though the weight of a ball increases its centripetal force, it increases its centrifugal force in the same proportion.

27. What do you understand by the mechanical powers?—The mechanical powers are certain contrivances, such as the wedge, the screw, the inclined plane, and other elementary machines, which convert a small force acting through a great space into a great force acting through a small space. In the school treatises on mechanics, a certain number of these devices are set forth as the mechanical powers, but not a tithe of the contrivances which accomplish the stipulated end are represented, and there is no need for considering the principle of each separately, for the principles of all are one and the same. Every pressure acting with a certain velocity is convertible into a greater pressure acting with a less velocity, but the quantity of mechanical force remains unchanged by this transformation, and all that the implements called mechanical powers accomplish is to effect this transformation.

28. Is there no power gained by the lever?—Not any: the power is merely put into another shape, just as the contents of a hogshead of porter are the same, whether they be let off by an inch tap or by a hole a foot in diameter. There is a greater gush in the one case than the other, but it will last a shorter time; and when a lever is used there is a greater force exerted, but it acts through a shorter distance. It requires just the same expenditure of mechanical power to lift 1lb. through 100 feet as to lift 100lbs. through one foot. A cylinder of a given cubical capacity will exert the same power by each stroke whether the cylinder be made tall and narrow or short and wide; but in the one case it will raise a small weight through a great height, and in the other case a great weight through a small height.

29. Have no plans been projected for gaining power by means of a lever?—Yes, many plans: some of them displaying much ingenuity, but all displaying a complete ignorance of the first principles of mechanics. I have occasionally heard persons say 'You gain a great deal of power by the use of a capstan; why not apply the same resource in the case of a steam-vessel, and increase the power of your engine by placing a capstan motion between the engine and paddle wheels?" Others I have heard say, "By the hydraulic press you can obtain unlimited power: why then not interpose a hydraulic press between the engine and the paddles?" To these questions the reply is sufficiently obvious. Whatever you gain in force you lose in velocity; and it would benefit you little to make the paddles revolve with ten times the force, if you at the same time caused them to make only a tenth of the number of revolutions. You cannot by any combination of mechanism get increased force and increased speed at the same time, or increased force without diminished speed; and it is from the ignorance of this inexorable condition that such myriads of schemes for the realisation of perpetual motion by combinations of levers, weights, wheels, quicksilver, cranks, and other mere pieces of inert matter, have been propounded. Any such combination can never increase power nor diminish it either, except by frictio

30. What is friction?—Friction is the resistance experienced when one body is rubbed upon another body, and is the result of the natural attraction bodies have for one another, and of the interlocking of the impalpable asperities upon the surfaces of all bodies, however smooth. When motion in opposite directions is given to surfaces so constituted, the asperities of one surface must mount upon those of the other, and both will be abraded and worn away, in which act power must be expended. The friction of smooth rubbing substances is less when the composition of those substances is different, than when it is the same, the particles being supposed to interlock less when the opposite prominences and asperities are not coincident.

31. Does friction increase with the extent of rubbing surface?—No; the friction, so long as there is no violent heating or abrasion, is simply in the proportion of the pressure keeping the surfaces together, or nearly so. It is, therefore, an obvious advantage to have the bearing surfaces of steam-engines as large as possible, as there is no increase of friction by extending the surface, while there is a great increase in the durability. When the bearings of an engine are made too small they very soon wear out.

32. Does friction increase in the same ratio as velocity?—No; friction does not increase with the velocity at all, if the friction over a given amount of surface be considered, but it increases as the velocity, if the comparison be made, with the time during which the friction acts. Thus the friction of each stroke of a piston is the same, whether it makes 20 strokes in the minute or 40: in the latter case, however, there are twice the number of strokes made, so that though the friction per stroke is the same, the friction per minute is doubled. The friction, therefore, of any machine *per hour* varies as the velocity, though the friction *per revolution* remains at all velocities the same.

33. Can you give any approximate statement of the force expended in overcoming friction?—It varies with the nature of the rubbing bodies. The friction of iron sliding upon iron, has generally been taken at about one-tenth of the pressure when the surfaces are oiled: the friction of iron rubbing upon brass has generally been taken at about one-eleventh of the pressure under the same circumstances. These numbers, however, have been disputed by some persons, and there is a good deal of uncertainty yet hanging about the subject.

34. What do you understand by a horse-power?—An amount of mechanical force that will raise 33,000lbs. one foot high in a minute. This standard was adopted by Mr. Watt, as the average force exerted by the strongest London horses—the object being to enable him to determine the relation between the power of a certain size of engine, and the power of a horse, so that when it was desired to supersede horses by an engine, he might, from the number of horses used, determine the size of engine that would be suitable for the work.

35. Then when we talk of an engine of 200 horse-power, is it meant that the impelling efficacy is equal to that of 200 horses, each lifting 33,000lbs. in a minute?—No, not now: such was the case in Watt's engines, but the capacity of cylinder, answerable to a horse-power has been increased by many engineers, and the pressure on the piston has been increased also, so that what is now called a 200 horse-power engine exerts almost in every case a greater power than what 200 horses would do, so that the horse power has become a mere conventional unit for expressing a certain size of cylinder, without reference to the power exerted.

36. Then each nominal horse-power of a modern engine may raise much more than 33,000lbs. one foot high in a minute?—Yes; some raise 52,000lbs., others 60,000lbs., and others 66,000lbs., one foot high in the minute, by each nominal horse-power; and therefore no comparison can be made between the performances of different engines, unless the power actually exerted be first discovered.

37. How is this discovery made?—By means of an instrument called the indicator, which consists of a small cylinder, about an inch in diameter, fitted with a piston, which is pressed down by a spring. This piston, by the height to which it rises, indicates the pressure within the cylinder, and the number of pounds pressure on the square inch multiplied by the number of square inches on the piston and the number of feet travelled through by the piston per minute, gives the amount of impelling force. From this a trifling deduction is to be made for friction,

&c., and the remainder is the effective moving force which, divided by 33,000, gives the actual horse-power.

38. What quantity of steam is supposed to be consumed by engines per horse-power?—About 33 cubic feet per minute, according to Mr. Watt's rule, or a cubic foot of water raised into steam per hour which is the proportion assumed by many persons, and which nearly agrees with that adopted by Mr. Watt. Any such rules, however, can only have a very partial application in modern engines, as it is now the common practice to work engines more or less expansively, and, in such cases, less than the former quantity of steam is used.

39. What is meant by working engines expansively?—Adjusting the valves so that the steam is shut off from the cylinder before the end of the stroke, whereby the residue of the stroke is left to be completed by the expanding steam.

40. And what is the benefit of that practice?—It accomplishes an important saving of steam, or, what is the same thing, of fuel but it dimiuishes the power of the engine, while increasing the power of the steam. A larger engine, will be required to do the same work, but the work will be done with a smaller consumption of steam. If, for, example, the steam be shut off when only half the stroke is completed, there will only be half the quantity of steam used. But there will be more than half the power exerted, for although the pressure of the steam decreases after the supply entering from the boiler is shut off, yet it imparts, during its expansion, *some* power, and that power, it is clear, is obtained without any expenditure whatever.

41. Can you give any rule for ascertaining the amount of benefit derivable from expansion?—Divide the length of stroke through which the steam expands by the length of stroke performed with full pressure, which call 1, the hyperbolic logarithm of the quotient is the increase of efficiency due to expansion. According to this rule it will be found, that if a given quantity of steam, the power of which working at full pressure is represented by 1, be stopped at one half the stroke, its efficacy will rise to 1·69; if stopped at one-third 2·10; at one-fourth 2·39; at one-fifth 2·61; at one-sixth 2·79; at one-seventh 2·95; at one-eighth 3·08. The expansion, however, cannot be carried beneficially so far as one-eighth, unless the pressure of the steam in the boiler be very considerable, on account of the inconvenient size of cylinder or speed of piston, the friction of the engine, and the resistance of vapour in the condenser, which all become relatively greater with a smaller urgiug force.

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## Art. VII.—THE CONSTRUCTION OF SEWERS.

The inquiries of the commission on the health of towns have elicited much valuable information respecting the sewerage of the metropolis. It appears that, through the incompetency or interested efforts of sewer commissioners, improper lines have been selected, which have required a great expenditure to keep them in even a tolerably efficient state, and which are quite insufficient for the present exigeucies of their respective districts. Through the system of jobbing which has found a place in these courts, the construction of sewers has been very carelessly performed, and recent failures, arising both from imperfection of design and workmanship, have attested the necessity of transferring the powers of the present boards to some more competent and disinterested authorities.

There is considerable diversity in the form of sewers used in the metropolis, most of which are very defective, and the following figures, representing some which have given way, will be of some service in determining the adoption of a better plan.

Fig. 1.

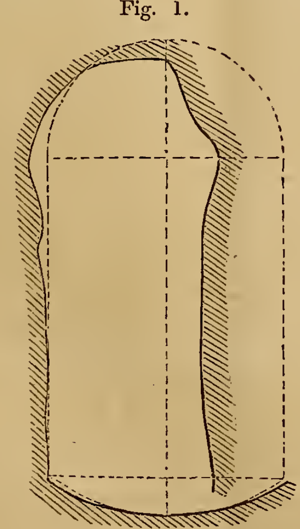


Fig. 1, is a section of a sewer at Notting-hill, as it appeared after failure the dotted lines representing the original form. It will be seen tha the pressure of the earth, as might have been predicted, forced in the high straight walls, which are the abutments of the arch, but which are incapable of resisting lateral pressure inwards.

Fig. 2.

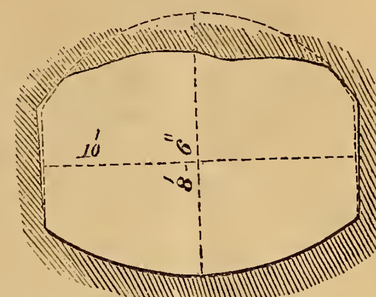



Fig. 2, is a sewer on the Uxbridge road, 10 feet wide, and 8 feet 6 inches high. In this case the top curve is too flat, and the pressure upon it tending to straighten it, which increases with the flatness of the arch, pressed the side walls over at the top, the ground having besides been imperfectly rammed behind the walls. The cost of this sewer was above 3*l*. per foot.

Fig. 3.

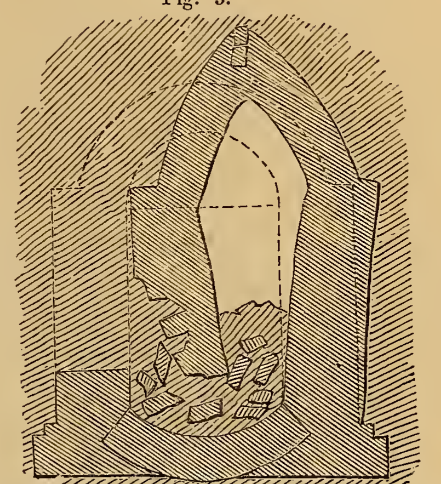
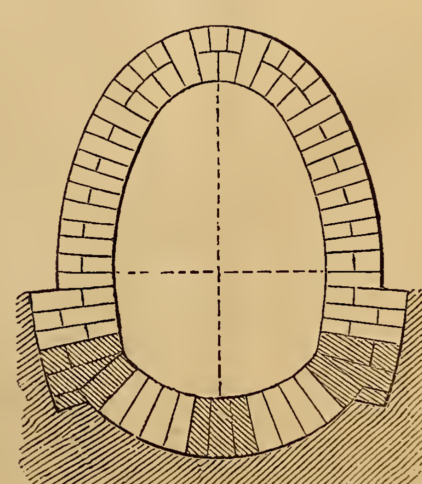


Fig. 3. is a view of a sewer near the Harrow road, which gave way in consequence of a ground slip. This sewer, which is 5 feet 5 inches high, and 2 feet 6 inches wide, is situated upon the side of a turnpike road, the vibrations upon which, caused by the traffic, would increase the slipping tendency of the road. The ground also does not appear to have been properly rammed at the back of the walls, where the water from the road-

Fig. 4.

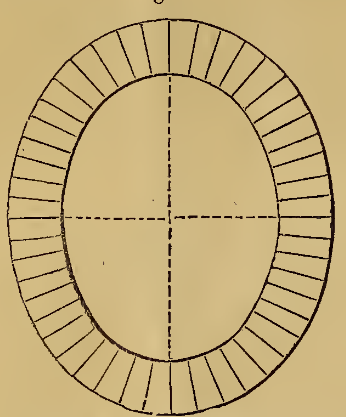


way accumulated. The same defect exists in this as in Fig. 1; the walls being flat are not adapted to resist any lateral pressure inwards.

The court in whose jurisdiction this failure occurred have adopted the form of sewer shown in fig. 4. which strangely enough was rejected by their predecessors, about forty years ago, when Mr. Rennie proposed its adoption.

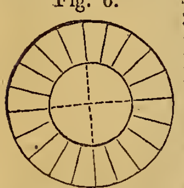
Mr. Rennie then remarked respecting the form of sewer which shonld be used:—" I have no hesitation in saying that it ought to be made like a canal tunnel; the bottom should be an inverted arch, the sides curved, the top a kind of ellipsis approaching nearly to a parabolic form, having the longer axis upwards; the pressure is generally most irregular at the top, there beiug so much earth above, and therefore the form should be suited to sustain that irregular pressure." This is the form which is now generally approved for sewers; it combines the strength of a circular form with the wide water way of a rectangular form. The invert and springing of the side walls are bedded in concrete, the greatest width is 3 feet, and the height 4 feet 6 inches.

Fig. 5.



In Bristol, the drainage of which has been much neglected hitherto, the new sewers are made of an elliptical form, similar to that shown in fig. 5; the transverse and conjugate diameters being in the ratio of four to three. They are made of nine inch brick, and of various sizes, the largest being 4 feet by 3 feet, and the others, 3 feet 3 inches by 2 feet 6 inches, 2 feet 8 inches by 2 feet, and 2 feet by 1 foot 6 inches. When smaller drains are required, a circular form is used, 14 inches in diameter, as shown in fig. 6. The fall which is adopted in Bristol, when it can be had, is 1 in 60, but frequently 1 in 360, is all that can be obtained. For branch drains, the elliptical drains might be used; for house-drains, to connect dwellings with the sewers, we conceive that pipes either of cast iron, or of earthenware, which could be easily flushed with the ordinary water supply of private houses, would be found the most efficacious. The whole subject of drainage is one of vast and increasing importance, and improvement is certain when so much attention is conceutrated upon it.

Fig. 6.



## ART. VIII.—NORFOLK RAILWAY ACCIDENT.— MR. STEPHENSON'S REPORT.

AN accident, attended with loss of life, has occurred on the Norfolk Railway during the experiments on the narrow gauge from the engine running off the rail; and at the coroner's inquest General Pasley has given evidence illustrative of the merits of different gauges, and of the engines of rival manufacturers, which, to say the least, is exceedingly indecorous and imprudent. We have, on various occasions, offered our tribute of praise to General Pasley for the manner in which he has filled the difficult office of Inspector-General of Railways, and have acknowledged the services he has rendered in that capacity to the public; but praise and power seem to have turned his head, and we now find him departing from the duties of his office, and pronouncing oracularly respecting disputed technical questions with which he has nothing to do, and respecting which his information must necessarily be slender. The General, it appears, found himself at issue with Mr. Bidder on some of the points controverted, but instead of the disagreement inducing diffidence as to the soundness of his own couclusions, it led to some such declaration as that Mr. Bidder is ignorant of the first principles of mechanics! If Mr. Bidder be thus ignorant, what must be the limits of General Pasley's information? Does any living creature suppose that General Pasley has a tenth of the depth or a tenth of the engineering experience possessed by Mr. Bidder? or will any other inference be drawn from the General's declaration, than that he has sought to fortify an untenable position, by overstepping the limits of ordinary courtesy, and turning to the resources of vulgar braggadocio? General Pasley has published a letter in the *Times* explanatory of his evidence, in which he speaks with approbation of many of the railway works executed by Mr. Bidder, but assumes such a patronising air in according his praise, as to bring upon his pretensions a tinge of magnificent folly. Is General Pasley, then, the sole oracle and depository of engineering science? Is his name a shrine before which all men must bow in silent adoration, or is he a heaven-born genius, to whom a few occasional rides upon an engine can impart more instruction than is to be attained on such subjects by ordinary mortals in a lifetime of undivided attention and assiduous toil? It would be mere irony to suppose that General Pasley possesses any more enlarged information respecting mechanical engineering than is attainable in a few years of desultory application by any military amateur; yet General Pasley sets up, not only for the equal, but for the superior of our ablest engineers, and presumptuously sits in judgment upon their qualifications. We are confident that the government cannot approve of the course General Pasley has adopted, as respect must be preserved at least for the office, and it is moreover most indecorous towards the gauge commissioners, that another government official should prejudge the question entrusted to their investigations. Geueral Pasley's letter in the *Times*, explanatory of his evidence, is too poor, both in arguments and facts, in anywise to improve his position, and more remarkable for its weakness and egotism than for any other quality. We shall, however, here give insertion to a report by Mr. Robert Stephenson, on the causes of the Norfolk accident, which sets the question in a clear light. This report is a most able production in every way; it is strong both in facts and arguments, aud is temperate and diguified at the same time that it annihilates General Pasley. Let the General beware, for the future, how he provokes the replication of such an antagonist; the questions which vex the engineering world are not fit subjects for men of his small intellectual stature, or at least are not subjects upon which they should publicly commit themselves, unless they desire to run the risk both of derision and of blame.

TO THE DIRECTORS OF THE NORFOLK RAILWAY.

Geutlemen,—Absence from London on urgent business has prevented me complying earlier with your request that I should report to you my observations on the statements made in the evidence given at the inquest on the late accident upon the Norfolk Railway.

I returned to town last night, and now proceed to lay before you such remarks as have suggested themselves. In the outset I may state, that I concur generally with the engineering evidence given by Mr. Bidder and Mr. Marshall. I shall therefore confine my observations to the evidence of General Pasley, but before I direct your attention to the individual statements, I must observe, that I have experienced considerable difficulty in dealing with them, in consequence of their being merely expressions of opinion, without adducing arguments or specific facts to support them. If the General had, after giving an opinion, stated the particular reasons or result of calculations which led him to such conclusions, then their validity might have been tested. In the present instance such a course is doubly necessary, because the subject, from the tone assumed, is made not merely a scientific one, but one involving professional character. I shall, however, confine my remarks to the former.

General Pasley commences by stating that the description of engine was one of " extraordinary leugth, of such a length as was uever used on the narrow or any other gauge."

From this statement everybody would conclude that this class of engine was not in very general use; that little or no experience had been obtained of its peculiarities; that it was an experimental eugiue possessing several obvious defects.

Against this assumption I only think it necessary to state the fact that upwards of 150 engines of this description have been in daily use in this country and on the continent for the last two or three years; that the long boiler has, by every experienced and impartial locomotive manager with whom I have communicated, beeu received as a decided improvement; so much so, that since this class of engine was first introduced, the boilers of old engines have been, in several cases within my own knowledge, very cousiderably lengthened; thus offering the most incontestible proof that the old construction of engine is admitted to be deficient in length of boiler. You will bear in mind that I am now speaking of the boiler simply; the other parts of the construction of the engine upon which General Pasley offers an opinion I shall come to afterwards. I need hardly say, that during the working of such a number of engines over such a length of time, it is impossible to conceive the avoidance of accident, if this construction of eugiue involved danger to the extent stated by General Pasley; but, as if to meet this argument, the General in his evidence qualifies his opinion of danger by saying, "that such an engine as the one iu question can go at 30 or 35 miles an hour, and I think I have gone 45 miles upon them."

I can only state my own experieuce leads me to a different couclusion, and that I have frequently been upon this descriptiou of engine when the speed far exceeded those above referred to, without the slightest accident occurring.

Oscillation in the body of the engine at high velocities I regard as inevitable, no matter what the construction may be; but this oscillation arises from causes which cannot have come within the Inspector General's sphere of observation. It is only the practical man whose opinion on such points can be depended upon; it is not the occasional riding upon an engine that can enable auy one to decide between the construction of one class and another, or to decide that dangerous oscillation is caused by an overhanging firebox or a long boiler. In a word, to decide a point of this kind it is absolutely essential to examine the condition of the engine as well as its construction; for instance, the steadiness of all six-wheeled engines essentially depends upon three conditions,—

1. The distribution of the weight upon the three axles.
2. The lateral play in the bearings.
3. The distance between the extreme axles, that is, the extreme length of bearing upon the rails.

Of these the last only is permanent; the two first are constantly subject to change. An engine which is perfectly safe and comparatively steady to-day may become unsteady, and even dangerous at high speeds, in a short time, by an alteration either in the springs or by the lateral wearing of the bearings. Now, I have reason to know that the White Horse of Kent, the only engine which General Pasley quotes as having oscillated excessively, although he has tried several others, was not in the best working condition at the time he made the experiment; no opinion with reference to its motion could therefore with propriety be drawn without taking into account the condition in which the bearings were at the time, together with the disposition of weight upon the wheels.

All engines when allowed to get play upon the bearings become unsteady at high velocities, and oscillation from this source is aggravated if more than a due proportion of weight be thrown upon the middle pair of wheels.

I believe nearly all the accidents which have occurred by engines leaving the rails are mainly attributable to want of attention to this condition.

In bad weather, when the rails are slippery, the temptation to the engineman to increase the weight upon the driving-wheels is very great, and I have frequently known it carried to an improper extent. How far this may have operated in the Norfolk Railway accident cannot now be ascertained, but, referring to that which took place during the progress of the experiments on the Great North of England Railway, under the Gauge Commission, I have ascertained that this improper distribution of weight was one of the chief causes of the engine leaving the rails. On a piece of absolutely perfect road this cause would iu all probability not have produced the result, but in cases of this kind the ultimate result seldom, very seldom indeed, flows from one cause; it is the concurrence of two or more circumstances operating in the same direction.

If accidents on railways arose from any peculiarities of construction in the engiue, we ought to have them every day. If the overhanging firebox so much objected to by General Pasley were dangerous, it would be absolntely impossible to work the London and Birmingham one day without a series of accidents. The engines upon that linc have fireboxes projecting beyond the bearing axle fully 4 feet 6 inches, being five inches more than the corresponding projection of the Norfolk engine. The London and Birmingham line has been worked now nearly eight years with an unparalleled traffic with engines having overhauging fireboxes, without any accident which can fairly be attributed to such a peculiarity of construction.

I originally objected to this projection of the firebox beyond the axle; but, after an experiment continued uninterruptedly for a series of years, with an enormous traffic, it would be absurd to reject such practical evidence and to hold such an opinion.

It was this opinion that led me to the construction of the new long-boiler engine, and the abandonment of the objection I originally entertained and acted upon. When I considered, moreover, that the London and Birmingham engiues had, in addition to the overhanging firebox, a remarkably short bearing upon the rail, and, consequently, admitting of the overhanging weight operating with increased effect, the testimony appeared to me conclusive.

The London and Birmingham engines in the commencement had a bearing upon the rail of only $5\frac{1}{2}$ feet (they have since been extended), whereas the Norfolk engines have a bearing of $10\frac{1}{2}$ feet. On this point I ueed not confine my reference to the engines upon the London and Birmingham, because they are not peculiar to that line; they are to be fonnd on many others.

Whatever may be the effect of such evidence upon the minds of others, I must confess that to me it appears perfectly conclusive that the overhanging box exercised no influence such as General Pasley imagines.

In confirmation of this, I may state that yesterday, with a passenger train of 40 tons, with a boisterous side wind, I came from Darlington to York on the A engine, which has an overhanging box and long boiler, accompanied by Mr. T. E. Harrison, Mr. Fletcher, and Mr. Joseph Stephenson, for the express purpose of trying the oscillation of the engine. For several miles the speed exceeded 50 miles an hour, and in some we passed the consecutive quarter mile posts in 15 seconds, being 60 miles an hour. In addition to the overhanging firebox, we were all standing on the foot-plate with the engineman, excepting Mr. Joseph Stephenson; consequently the circumstances were peculiarly calculated to excite oscillation, if the tendency existed to any appreciable extent. I am, however, enabled to declare most positively that this engine was not only entirely free from any dangerous oscillation, but as steady as any engine I ever rode upon. Here I will leave the question of overhanging firebox, and proceed to notice the next peculiarity of the Norfolk engine specially noticed by General Pasley, viz., "The wheels being huddled together."

In looking at this part of the subject, I am relieved from any discussion as to matters of opinion; it is simply one of dimension, which admits happily of no dispute. I therefore give you the dimension of Slaughter's engine, which the General returned to towu upon, and declared safe and steady, and those of the Norfolk engine, which he condemns:—

| | Ft. | In. |
|---|---|---|
| Slaughter's engine, distance between extreme axles ... | 11 | 0 |
| Norfolk engine, distance between extreme axles ... ... | 10 | 6 |

I leave the General to say whether this difference of six inches jnstifies the epithet, "huddled together" as applied by him to the wheels of the Norfolk engine.

The General, in another part of his evidence, says, "These engines (alluding to Slaughter's), although they are of a long boiler construction, have no overhanging weight like Mr. Stephenson's." This, like the last, is merely a question of dimension, the fact being that at the chimney end Slaughter's engine overhangs precisely to the same extent as the Norfolk engine, viz., 4 feet 9 inches; at the firebox end in Slaughter's engine the axle is placed underncath the middle of the firebox, whereas in the others it is placed immediately iu front of it, without, however, giving the engine more than 6 inches additional base upon the railway, and this in a distance of 11 feet; yet this shade of difference, according to the General, makes the one engine safe and steady, and the other dangerous and apt to "roll like a vessel at sea," and this without reference to the fact that the centre of gravity of the Norfolk engine is fully a foot lower than Slaughter's. Were it necessary to adduce any further evidence, it would only be necessary to recall to mind the base of the London and Birmingham engines, where, with an overhanging firebox, the base at the rail does not exceed 7 feet.

I do not think that comment on such a conclusion is necessary; if a shade of difference of this kind be really adequate to produce such consequences as are here stated by the Inspector-General, the sooner the construction of every class of locomotive engine is revised the better.

General Pasley states in another part of his evidence, that "the narrow gauge not offeriug so great a diameter of boiler as the broad, Mr. Stephenson, to remove the obstacle, constructed the long boiler engines, to equal them in power, and they have failed in the purpose for which they were intended." Aud again, "that owing to the fore part of the boilers being so far from the firebox, the tubes being so much distant, the engines do not afford the power that was expected from them."

This paragraph I have no hesitation in declaring to be entirely erroneous. In the first place, the motive for lengthening the boiler had uo reference to gauge at all, because it is equally applicable to all gauges; the object was to save fuel, by preventing the escape of a large quantity of waste heat up the chimney; in this it has been perfectly successful, which has been established by every experiment tried with this object. Even with the longest tube yet introduced in locomotive engines, the temperature at the chimney end has been found sufficient to melt lead, which is upwards of 200 degrees above the temperature of the water in the boiler. The opinion of General Pasley on this point is equally at variance with the most extensive experience with stationary engine boilers; which are much longer, with much less velocity of draught.

It must be obvious to every one that every addition to the economy of fuel obtained by an enlarged evaporatory capacity is necessarily attended with a corresponding increase of power, and therefore, as before observed, although my original object in lengthening the boiler was with the view of economical results, it has been attended with a large increase of power. I beg therefore to remove the impression produced by General Pasley's evidence, by emphatically declaring that the long boiler arrangement suggested itself to my mind, indeed was in actual operation, years before the question of gauges was agitated. I forbear here going into the question of gauge, which has been so pointedly introduced by General Pasley both in his evidence and in his letter in the *Times*, because it is both foreign to the subject and can lead to no result whilst it is under the consideration of the commission appointed for that purpose.

In conclusion, I am willing to believe, nay, I am sincerely convinced, that General Pasley, in giving his evidence, was actuated by no other motive than a wish to arrive at the truth, but in the present instance I must be excused for regarding him as having ventured to give opinions upon a difficult subject, and one with which neither his education nor experience can have made him thoroughly acquainted. In venturing thus to express myself, I am far from wishing to imply the least disrespectful feeling to General Pasley; on the contrary, my experience in the mode in which he has filled the difficult office of Inspector-Geueral has led me to respect him, and at all times to aid him by giving him opinions on practical subjects whenever an opportunity presented itself; but in the present case I am so personally involved by his evidence, and feel so strongly convinced that his views are entirely erroneous, and calculated to injure railway interests, that to express my opinion with any reservation would be injustice to many railway companies whose confidence I enjoy. I am, Gentlemen, your obedient servant,

Robert Stephenson.

## ART. IX.—REPORTS.

RECOMMENDATIONS OF THE COMMISSIONERS FOR INQUIRY INTO THE STATE OF LARGE TOWNS AND POPULOUS DISTRICTS.

1. That, in all cases, the local administrative body, appointed for the purpose, have the special charge and direction of all the works required for sanatory purposes, but that the Crown possess a general power of supervision.

2. That, before the adoption of any general measure for drainage, a plan and survey upon a proper scale, including all necessary details, be obtained, and submitted for approval to a competent authority.

3. To render unnecessary the frequent application to Parliament for additional powers, and extension of jurisdiction, that the Crown be empowered to define and to enlarge from time to time the area for drainage included within the jurisdiction of the local administrative body.

4. That the local administrative body appoint the executive and other officers under it; that the appointment and dismissal of the chief surveyor be subject to approval; that such officer produce proof of his qualification for the office to which he shall be appointed, and, if required, be subject to an examination.

5. That, upon representation being made by the municipal or other authority, or by a certain number of the inhabitants of any town or district, or part thereof, setting forth defects in the condition of such place, as to drainage, sewerage, paving, cleansing, or other sanatory matters, the Crown direct a competent person to inspect and report upon the state of the defects, and, if satisfied of the necessity, have power to enforce upon the local administrative body the due execution of the law.

6. That the management of the drainage of the entire area, as defined for each district, be placed under the jurisdiction of one body.

7. That the local administrative body be empowered to raise money for purchasing the rights of mill-owners and others, where the mill dams or other obstructions injuriously affect the drainage of the district comprised within the area defined; inquiry in each case having been previously made by the proper officer into the necessity of the purchase, and the amount to be paid.

8. That the construction of sewers, branch sewers, and house drains, be entrusted to the local administrative body.

9. That the landlords of houses be rated for the purposes of the Act, when the houses are let in separate apartments, or when the rent is collected more frequently than once a quarter, or when the yearly rent is less than 10*l.*, such a deduction being made from the gross amount of the rate, as may be considered a fair equivalent for the labour and losses incident to the collection of rents on such property.

10. That the duty of providing the funds necessary be imposed upon the local administrative body, and that the cost of making the main and branch sewers be equitably distributed among the owners of the properties benefitted; and that the expense of making the house-drains be charged upon the owners of the houses, to which the drains are attached. That the expense remain a charge upon the properties, to be levied by a special rate upon the occupiers, and recovered with interest by annual instalments within a certain number of years, unless the owners prefer to pay the cost in the first instance, and except in the cases mentioned in the ninth Recommendation.

11. That some restriction be placed on the proportionate rates in the pound to be levied in each year, but if the local administrative body finds that there is need for larger funds, for the immediate execution of works for sanatory measures, than can be provided by such rates, it be empowered to raise, by loan on security of the rates, subject to the approval of the Crown, such sums as may be requisite for effecting the objects in view. Also, that provision always be made for the gradual liquidation of such debts, within a limited number of years.

12. That the whole of the paving, and the construction of the surface of all streets, courts, and alleys be placed under the management of the same authority as the drainage, and that the limits of jurisdiction for both purposes, wherever practicable, be co-extensive; also that the principle above submitted in respect to the cost of making drains and sewers, and the equitable distribution of the expense, be adhered to in the case of laying out, levelling, and paving of streets, courts, and alleys; but for the purpose of ensuring the greatest efficiency and economy in the execution of the work, it be performed by the local public officers.

13. That the provisions in local acts, vesting the right to all the dust, ashes, and street refuse in the local administrative body, be made general; and that the cleansing of all privies and cesspools at proper times, and on due notice, be exclusively entrusted to it.

14. That many of the more common nuisances which prevail within towns, such as large collections of dung, be declared nuisances, and be summarily abated.

15. That after such a period as it may be deemed advisable to fix, the provisions in local acts for preventing the escape of dense black smoke from furnaces and steam-engines in towns, be made general. That these provisons be applied, so far as it is practicable, to steam-boats usually plying within the limits of any city or town subject to the operation of such act.

16. That in cases where complaints shall be substantiated that the inhabitants of any house, street, or district, in towns, are injuriously affected by the noxious exhalations of any factory, power be given to the local administrative body to ascertain the cause of such exhalations, and to take legal proceedings for the abatement of the evils, in the event of such evils not being removed on due representation.

17. That it be rendered imperative on the local administrative body, charged with the management of the sewerage and drainage, to procure a supply of water in sufficient quantities, not only for the domestic wants of the inhabitants, but also for cleansing the streets, scouring the sewers and drains, and the extinction of fire. That for this purpose the said body have power to contract with companies or other parties, or make other necessary arrangements.

18. That where any independent body has the management of the supply of water, it be liable to comply with the demand of the local administrative body on equitable terms; and that, further, the local administrative body be empowered to purchase the interest in water-works, subject to the control of the Crown, whenever the proprietors are willing to dispose of them. That on the establishment of new companies, it be made a condition, that the local administrative body be enabled to purchase the works after the lapse of a certain number of years, upon certain terms, and upon a rate of interest to be fixed; and that, with a view to economy, competition between water companies be discouraged as far as practicable.

19. That as soon as pipes are laid down, and a supply of water can be afforded to the inhabitants, all dwelling-houses capable of benefitting by such supply be rated in the same way as for sewerage and other local purposes; and the owners of small tenements be made liable to pay the rates for water, as we have already recommended in respect to drainage.

20. That every facility be afforded to furnish ample supplies of water to public baths and washhouses that may be established for the use of the poorer classes.

21. That for increasing the protection of property from fire, in all cases, the supply of water in the mains be not only constant, but also at as high a pressure as circumstances will permit, and that fire-plugs be inserted in the mains at short intervals.

22. That, subject to proper control, the local administrative body be empowered to raise money for the purchase of property, for the purpose of opening thoroughfares, and widening streets, courts, and alleys, so as to improve the ventilation of the densely crowded districts of towns, as well as to increase the general convenience of traffic.

23. That with the view therefore of ensuring better external ventilation, courts and alleys be not built of a less width than twenty feet, and that they have an opening of not less than ten feet from the ground upwards at each end; the width of the court being in proportion to the height of the houses.

24. That provisions against the evils of cellars be made general, and that after a limited period the use of cellars as dwellings be prohibited, unless the rooms are of certain dimensions, are provided with a fire-place and window, of sufficient size, and made to open, and have an open space in front; and that the foundations be properly drained.

25. That public necessaries and drains for the removal of refuse from houses be made general, and that all new houses be provided with proper necessaries for the accommodation of the inmates.

26. That measures be adopted for promoting a proper system of ventilation in all edifices for public assemblage and resort, especially those for the education of youth.

27. That on complaint of the parish medical or other authorised officer, that any house or premises are in such a filthy and unwholsome state as to endanger the health of the public, and an infectious disorder exists therein, the local administrative body have power to require the landlord to cleanse it properly, without delay; and in case of his neglect, or inability to do so, by its own officers, and recover the expense from the landlord.

28. That magistrates have power to license and to issue rules, to be approved of by the Crown, for the regulation of lodging-houses for the reception of vagrants, trampers, and other such wayfarers.

29. That the local administrative body have power to appoint, subject to the approval of the Crown, a medical officer properly qualified to inspect and report periodically upon the sanatory condition of the town or district, to ascertain the true causes of disease and death, more especially of epidemics, increasing the rates of mortality, and the circumstances which originate and maintain such diseases, and injuriously affect the public health of such town or populous district.

30. That for the purpose of aiding the establishment of public walks, in addition to the legal facilities adverted to, the local administrative body be empowered to raise the necessary funds for the management and care of the walks when established.

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ABSTRACT OF EVIDENCE BEFORE SELECT COMMITTEE ON ATMOSPHERIC RAILWAYS.

*Bergin, Thomas Fleming.* Mr. Bergin had both parts of the line from Dublin to Dalkey especially under his care, and made many experiments upon them. The Dalkey line is $1\frac{3}{4}$ statute miles in length; Dalkey is $71\frac{1}{2}$ feet higher than Kingstown. He had objections to the form of the outlet valves, the loss of power arising from it amounting to $8\frac{1}{2}$ horse power; iu the pumps which Mr. Field has made for the Croydon Railway Company, there is a contrivance which will reduce this loss of power to two or three horse power. There are evils, besides loss of power, arising from large outlet-valves.

There has never been any accident to the valve, or any part of the apparatus, and the valve leakage is to be attributed to the cracking of the leather forming the joints of the valve. There is an important alteration in the construction of the valve upon the Croydon and Epsom Railway, which, instead of being pressed by a sharp edge, will be pressed by a smooth bar of iron; the leather, therefore, will not be exposed to a violent short bending from an abrupt edge.

There is a difficulty in calculating the loss of power on locomotive lines arising from curves, and separating it from the other resistances. The resistance of the atmosphere increases as the square of the velocity, and, as the whole of the Dalkey line is in a close canal, the atmosphere is more likely to have a hold on the trains than on ordinary lines.

There has been an increase in the number of first-class passengers, from the fact of allowing annual subscribers on the Dublin and Kingstown railway; discount being allowed, if several members of the family snbscribe. A continuous inclination, so that the train could perform the journey one way by gravity, would not tend to reduce the working expenses of the atmospheric apparatus, and it was the intention of the company, in the event of getting their line from Kingstown to Bray (seven miles), to make the highest point in the centre, one engine at the summit being capable of drawing three-and-a-half miles each way: the descent to be done by gravitation.

There was an accident on the Dalkey line on their second experimental trip: since the opening of the line there has been no accident of any kind whatever. The men stop the train with great precision and without difficulty, even when going at the highest velocity. On the atmospheric principle a perpendicular may be asceuded with safety, but if the breaksman neglects his duty, great risk is incurred in going down a steep incline with locomotives. The engines used ou the Dublin and Kingstown railway are as heavy as those used on long lines in England, with the exception of the Great Western. The atmospheric system is peculiarly applicable to Ireland, on account of the large supplies of water-power to be found there, by which exhaustion could be cheaply effected.

*Bidder, George Parker.* Mr. Bidder visited the Dalkey liue, made experiments there, and from his connexion with Mr. Robert Stephenson has been conversant with all the experiments that have been made under his direction. These experiments left no doubt in his mind that the atmospheric can be made an efficient tractive agent, but unless it can be worked commercially more advantageously than any other system, nothing in the world can command its universal application, and of this beneficial application it is not susceptible.

With proper regulations, the danger is hardly appreciable on the locomotive system, and the atmospheric system cannot be applied without great difficulty, unless electric telegraphs be used, which, on either system, and whether the lines be double or single, will always be productive of great advantage and economy.

*Brunel, Isambard Kingdom.* Mr. Brunel is engaged in the construction of the railway from Exeter to Plymouth, and previously examined the experiments at Wormwood Scrubbs and Dalkey, to satisfy himself as to the practicability of the atmospheric system. On the Dalkey line results at least as great were obtained as could be by any ordinary means of traction. The Exeter and Plymouth liue has been laid down entirely for a single line, which makes peculiar arrangements necessary at the stations. All level crossings have been avoided between Exeter and Plymouth, and the bridges over the line are of a less height by 18 inches than on locomotive lines, and those under the railway are of less substance and strength than usual, as the weight and vibration of the engines will be removed. Most of the slips on railways are caused by the vibration of the trains, which is principally due to the locomotives. Slips will be less likely to occur on an atmospheric than on a locomotive line upon embankments. All the bridges and viaducts on the Exeter and Plymouth line, which are made of timber, are of a lighter construction than those on the Bristol and Exeter Railway.

There will be no difficulty in maintaining the tube in working condition; no danger to passengers, nor even probable derangement of the traffic. On the Great Western the rails are 70lbs. per yard; on the South Devon, 50lbs.; and the latter will probably last the longest, and the gauge will be the same. The carriages on the South Devon will receive less rough usage and may be made more perfect than on a locomotive line. Loose wheels were used upon the Great Western, but were not found to produce any material advantage. In the event of slips the pipe could be easily replaced; apart from other conditions a slip is more likely to interrupt traffic upon a single than upon a double line; but when worked with a stationary power, a single line will, on the whole, be liable to less interruptions than a double line worked with locomotives. The longest detention of trains on the Great Western Railway has beeu five hours. In nine cases out of ten an obstruction could be removed more quickly upon an atmospheric line than upon a locomotive line.

It is more desirable to avoid level crossings upon an atmospheric line than a locomotive one, but upon either they should be avoided if possible. If all the gradients on the South Devon line had been as favourable as on the first twenty miles, the application of the atmospheric principle would still have been desirable. The circumstances which induced him to recommend its adoption, were the gradients, the superior comfort of the atmospheric principle, and the reduced cost of a single line. The objections to level crossings over an atmospheric railway chiefly concern the company; the public can have better notice of danger than on locomotive lines. Upon any system of working, good gradients are desirable, but the gradients ou the South Devon line are not such as materially to affect the speed; an enormous weight is necessary for a locomotive engine to enable it to carry a train at a high speed.

The only loss of power on the atmospheric principle, apart from imperfect machinery, arises from the attenuated air in the tube being heated, and having to be compressed by the air-pump; by which, however, the loss of power is not 10 per cent. Experiments have been tried on the Dublin and Kingstown line to protect the pipe from the external air, but no such plan would pay for the expense. On the South Devon line there will be different-sized pipes on the steepest gradients, or possibly a double pipe, and means are provided by which a train could pass at full speed from one part of a tube to another of a differeut diameter. It is intended that the engine in advance of that immediately in front of the train, should be at work at the same time, and that the force of both should operate upon the train, and one pair of engines will be sufficient to draw the trains at 50 or 60 miles an hour. The pipe will be contiuuous, except where there are crossings, which on the South Devon line are always at stations. There are means by which a continuity would be maintained between different sections of pipe, while more thau one engine was working a vacuum.

It is proposed to produce a half-vacuum in the pipe, by means of a large tank rapidly emptied of water, which will be in no danger of falling in from the pressure of the atmosphere. The water would be pumped up by a small auxiliary engine, which would pump water for the boilers also. By the removal of locomotives, the complication, extent, and unsightliness of railway stations would be very much reduced; and it is proposed to move the carriages and attach them to the train by a small capstan, as in the goods shed at Bristol. The atmospheric principle will lead to the working of more trains, and the number of carriages to each train would be reduced rather than the number of trains, to suit the traffic. There is an advantage in carrying exactly the load for which the machinery is best adapted; trains might be run conveniently each way every half hour. No more delay would be caused by the crossing of two lines than is sufficient for stopping at the station; but at such stations it would be necessary to have either a double set of engines or a reservoir, and the contrivance of a fixed point on the rails would divert meeting trains into different lines on arriving at a station; each train turning slightly out of the line to arrive at the other side of the station, and one train overtaking another at a station would be enabled to pass it. Trains will not be detained at crossing places more than three minutes for the exhaustion of the tube.

The difference between the fast and the stopping trains on the Great Westeru consists not so much in the actual speed as in the loss of time and speed by stoppages; five minutes are lost by stopping at a station, besides the time during which the train is stationary, whereas a stoppage on the atmospheric line would not amount to more than a minute and a half. The power of the stationary engines has been calculated as equal to a speed of 80 miles an hour, or 60 miles, allowing for leakage. The amount of leakage on a section of three miles would not be greater than that on the whole of the Dalkey line, because the tube would be better made with elastic joints. The whole distance from Exeter to Plymouth could be traversed at a speed of 60 miles an hour. A high speed is more easy to be attained on the atmospheric than on locomotive lines. There is no particular advantage in the system proposed by Messrs. Hallett; if more power be required there must be larger engines. There are no gradients on the South Devon that could not be descended with safety, even by locomotives; that the working expenses of the atmospheric system would be less than those of locomotive engines; this belief mainly induced its adoption on the South Devon line. The more frequent the trains the more favourable is the system; the tastes of the public may be better suited.

With reference to the South Devon line, he calculated that a double atmospheric line, stocked with the power, would cost less than one locomotive line without the power. The expedieucy of increasing the distance between the engines is very doubtful. The single line of the South Devon will be sufficient for its traffic, even if it should be as great as that of the London and Birmingham; the width of the line could not be increased without great expense. On the inclined planes there will be double lines of rail, as the descending trains may run down without a tube; this will give great facilities for meeting trains to pass each other. A locomotive line might be converted into an atmospheric; but the facilities with which this could be effected would depend upon the gradients, which would probably be different for the two lines. He has made some tunnels on the South Devon line which he would not have made for a locomotive line. It was originally proposed to combine the locomotive with the atmospheric principles on the South Devou line. No difficulty will arise from the circumstance of the South Devon being the continuation of a locomotive line; but, being at the end of a long line, it may be subject to irregularities in the arrival of the trains.

There can be very few locomotive engines ten years old, even if all their parts have been renewed in the meantime; two days out of three is hard work to keep them in order. Upon the Great Western they run, on an average, 150 miles each day on which they are at work; there are 150 engines to 250 miles. Short lines are always the most expensive, in regard to locomotive power. The per-centage of repairs upon a stationary engine would not amount to more than five or six per cent. The superiority of a stationary engine is, that it need not be worked at its full power, while a locomotive, to save weight, must generally be worked nearly up to its full power. Delays arising from the state of the rails in winter would be entirely obviated by the atmospheric principle ; no general cause of irregularity on an atmospheric line can be foreseen; the rails may be kept in better order, and the whole machinery may be more perfect than on a locomotive railway. There will be no difficulty in backing the trains if they should run beyond the station. A stationary engine will, in almost all cases, be a cheaper power than locomotives. The piston-carriage might be constructed so as to remove obstructions from the line.

*Cubitt, William.* Mr. Cubitt thinks that, with proper management, the atmospheric principle may be adapted both to the carriage of goods and passengers. It is well adapted for very hilly districts, to avoid expense in the formation of the railway, and also in the case of a large passenger traffic, requiring to go at short intervals and very quick. It is particularly applicable to short lines with a large number of passengers. It is doubtful whether it is equally adapted to a long line, under the same circumstances, but it is most probable that with experience and good management it will come to that.

In very long lines with great traffic, a double line would be preferable. With proper management, the length of line would make no difference as to the interval necessary between the trains. A long line well worked is only the result of a great many short ones put together; delay that would be occasioned by trains passing each other on single lines. Express trains would not be necessary on atmospheric lines working constant trains; on long lines with long intervals between the trains, express trains might be started between such trains. Each train must stop a short time at every crossing station, to allow the vacuum to be made.

It is quite possible to go from London to Exeter as fast by the atmospheric as by the locomotive principle. It would be quite possible to go from the Land's-end to the extremity of Scotland, without stopping at all, according to the atmospheric principle. The atmospheric principle might be adapted to form a continuation of a long existing locomotive line. Supposing a train to be delayed, there is no difficulty, in the atmospheric system, in making up the time so lost. He is not aware of any locomotive double line the whole work of which could not be performed by a single atmospheric line. A greater part, if not the whole, of the advantages of a double line, upon the length of a 100 miles, may be obtained by making, in particular places, 10 or 15 miles together double.

Higher velocities can be acquired and maintained on the atmospheric than on the locomotive system. Being once well established, a system of atmospheric traffic can be worked at less cost per train per mile than a locomotive. There would not have been any very great difficulty in obtaining a good locomotive line from Epsom to Portsmouth; he laid it down so originally, but would now prefer the atmospheric plan, upon the ground of expense.

It is difficult to say at what vacuum it is most economical to work an atmospheric line; it is not yet exactly known. Supposing the price of iron to keep up, he would be induced to put down wooden rails; they would be perfectly applicable to the atmospheric system. Favourable opinion entertained by him with respect to Mr. Hallett's valve. On both systems the heavier the train the greater power required to move it. In his estimate he takes a 1,000*l.* per mile for workshops and tool-houses, and 2,000*l* per mile for plant; this is the estimate for the London and York.

*Field, Joshua.* Messrs. Maudslay contracted for the engines on the Croydon line; such engines would continue in good order for 20 or 30 years, as we see in the waterworks: the average annual cost would not exceed 10s. per horse power, or 50*l.* a year in the two engines of 50-horse power. Cost of repairing the engines on the Blackwall Railway has been under this proportion—on that line, however, the engines work one at a time, while on the Croydon line they will both work together. The ordinary repairs to keep them in good working order might be done at night, or in the intervals. It is not at all necessary that these fixed engines should be high-pressure. Those on the Croydon Railway are low-pressure condensing engines, working the steam to twenty-five pounds upon the inch to commence with. The estimate of 10s. the horse power would include the repair of the pumps. They are not in the habit of contracting for the repair of engines.

The consumption of coal on the Blackwall Railway is at the rate of 3lbs. per horse-power, for every hour during which the engine is at work. If coke were used instead of coal the cost would not materially vary. On the Croydon line coke or anthracite coal will be used. The consumption of fuel will there be nearly in proportion to the power exerted, and not in proportion to the power of the engine. If the engines are working 78-horse power, they will consume five times 78 lbs. of coal per hour. Has seen no reason to doubt the statements of parties connected with the Dalkey Railway. The repairs of the engine on the Dalkey line have been very much beyond the average. The atmospheric principle will attain equal, if not greater speed, than the locomotive. The principal delay of a locomotive train arises from halting and getting up the speed again. An atmospheric train, with a very slight increase of speed, could afford to stop at stations, while a locomotive could not do so, and arrive in time. The Dalkey line, from its curves, is very unfavourable for an experiment of speed.

There is no tendency to remove the pipe from its place by the force of the load. The power may be used more economically than upon the Dalkey line, and the machinery altogether improved. A slight leakage would produce a vacuum between the valve and the piston before the starting of the train, but that would be a very slight imperfection in practice. If the tube be properly cast, there will be no leakage whatever through the iron. The expense of keeping a locomotive engine in repair is very much greater than that of stationary engines. The leakage on the Dalkey line between the piston and the valve must be caused by bad joints to the tube; the nearer the pumping engine is to the tube, the better both in point of time and expense.

The expense per train would be diminished according to the number of trains run. The power is transmitted from the air-pump to the train without any considerable loss of power; no serious delay need be apprehended; the apparatus could easily be kept in good working order; the train can pass from one section of the tube to another without stopping; the single line will be sufficient. The power required on the Dalkey line is probably greater than on other lines, as it is up hill all the way. At present the atmospheric principle might not answer so well with a single line upon a great trunk railway; more experience is needed before that is tried. An atmospheric line with severe gradients could be worked as easily as a locomotive line with better gradients.

*Gibbons, Barry Duncan.* Is engineer of the Dalkey and of the Kingstown and Dublin Railway. The rails are not worn at all, except at the curves; the breaks do not injure them, the inside of the tube is quite smooth; the piston requires no tallow. When the piston comes out of the tube there is scarcely any perceptible heat. The longitudinal valve has required repair where the leather was bad; it is easily repaired, and has never interrupted the working of the line. The frost has not affected the valve; it only requires a composition to be applied to it. Cost of the maintenance of the way; on a greater length of line the cost of wages, &c. would be very little greater.

On the Dublin and Kingstown line the haulage is very favourable, the expense of each train per mile on the atmospheric line would be much reduced if the traffic were great, irregularities which have occurred on the Dalkey line arose chiefly from inexperience; a train can be stopped with facility while running at full speed. Case in which the piston-carriage started without the others by accident; it was stopped by the break. An atmospheric train attains its full speed much more rapidly than a locomotive engine. Probable effect of the piston breaking; it would fly off and leave the carriages behind.

A locomotive engine could not travel with safety on such curves as those on the Dalkey line, at a great speed, the connecting-rod between the carriage and the tube does not rub against the side. The Dalkey line was commenced without experience, and there have been many errors and imperfections. Injury done to the steam-engine by an inexperienced engineer. A line properly constructed could be worked at thirty per cent. less cost. There is no reason why the engine should be worked at high pressure. There is much less noise on the atmospheric line, which is a great advantage in entering a town. Having charge of both kinds of lines, is confident that the atmospheric system secures most accuracy as to time. It is liable to a less number of accidents. Great velocity can be attained, but has discouraged it on account of the curves. No difficulty has been found in adapting the vacuum to the weight of the load; it is accomplished in a short time. The most economical vacuum to work at is at a pressure of seven pounds to the square inch.

*Locke, Joseph.* He has turned his attention to the atmospheric principle of locomotion; has attended to the experiments that were made upon Wormwood Scrubbs; has not witnessed the experiments at Dalkey, further than having read them and carefully considered them. Any evidence given by him would be founded on the tabulated experiments given by Mr. Stephenson in his Report, and also upon the facts and calculations stated by the promoters of the atmospheric system. It has succeeded as a mechanical problem. Is of opinion that it does not give greater safety than the locomotive; at the same time there is no reason for apprehending greater danger.

Has been over many of the railways abroad. Has travelled over the Brussels lines of railroad. Many of them consist of single locomotive lines. With a well-arranged system of police a single line of locomotive railway might be worked with the same, or very nearly the same, safety and punctuality as a double line. Some of the German lines are single lines, as are nearly the whole of the Belgian; the French are all double lines. There is no particular reason for doubting the ordinary punctuality of trains moving by atmospheric pressure. The effects of delay, however, are more to be dreaded from the working of the tube or the working of the engine affecting the whole system. On the atmospheric principle collision could not possibly take place other than at the station; with good regulations, there is no reason to apprehend danger at the stations.

Judging from the reports and from the opinions urged in favour of the atmospheric system, there is no reason for believing that it has any advantage over the locomotive with regard to the rate of speed. The wear and tear of the engine is increased by the increase of speed; it is very great. The cost of the repair of locomotives has diminished greatly in the last six years. The wear and tear upon the railway is increased by the weight of the engine; it increases in a ratio according to the increased speed. Difficulty of estimating the duration of a locomotive engine.

The expense of haulage per train per mile, even giving the atmospheric the benefit of the trains upon descending lines, is greater on the atmospheric than on the locomotive line. One of the greatest objections to the atmospheric system is, that it could not be economically applied to the working of the night traffic; the mail-train, for instance, must be worked at a very great expense. Difficulty of establishing lateral communications (branch railways for collieries, for instance) on atmospheric lines. The atmosphere has considerable influence on trains; the pressure of the atmosphere would be constant, but the effect would vary from different causes. More capital would be required to work the Guildford Branch of the South Western Railway on the atmospheric than on the locomotive principle, it being a single line of rail. The use of the electric telegraphic is very conducive to safety on either description of railway.

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## Art. X.—THE SOCIETIES.

Asiatic Society.—*Jan.* 17.—Prof. Wilson in the chair.—The Secretary read a letter from Capt. T. J. Newbold, relative to some remarkable tombs which he had visited near Chittoor, in North Arcot, having a close resemblance to the cromlechs and other Druidical remains of our own island, and attributed by the natives of India to dwarfs and fairies. The tombs covered an area of more than a square mile: a few only of them are erect, most of them having been thrown down by the *Wudras*, or stone-quarriers, who found it easier to take the ready-formed blocks and slabs of granite, of which they were constructed, than to excavate the adjacent rocks. The antiquarian and treasure-seeker had also aided in the destruction; and human bones, and fragments of terra-cotta, sarcophagi, and vessels were scattered around. Capt. Newbold examined several of the tombs, one of which, the most perfect, was formed of an enormous slab of granite, nearly square, laid flat on the ground, by way of floor, having four slabs of similar make, placed vertically on their sides, forming the walls; the whole being surmounted by a slab 13 feet by 12, and nearly 5 inches in thickness, placed horizontally on the top, like a roof. In one side, that facing the N.E., a circular hole is cut just large enough to admit a man to squeeze himself through. The writer, on creeping in, found the interior much encumbered with earth and stones. The sarcophagi containing the dead bodies were placed on the floor slab, and covered to the depth of three or four feet with earth. The bones were those of ordinary stature; and gave a complete contradiction to the vulgar belief that these tombs were the houses of a pigmy race, who had in ancient times resided in them, using the little round holes as their doors and windows,—a tradition which no doubt arose from the house-like appearance of the whole, the earth, in most cases having accumulated to the depth of two or three feet, or as high as the entrance holes. The tombs are generally surmounted by one or two circles of stone, placed, as at Stennis, and other similar remains in Britain, upright on their edges; those at the head and feet being higher than the rest. One tomb dug into by Capt. Newbold had evidently never been disturbed; the workmen had to make their way through earth as hard as brick; and with much difficulty they cleared the sarcophagus in a nearly perfect state. It was a coffin-shaped trough, rounded at the edges, and 6½ feet long; and filled with earth and human bones. It stood on 8 hollow legs of terra cotta, which rested on the floor-slab of the tomb. Under the coffin was a vessel of elegant shape, made of fine black clay,—a fragment of which was on the table, similar in form and material to some brought from the Neilgherries, also in the Society's Museum. There were other vessels of common red terra cotta, filled with earth. According to the natives they had found such filled with rice; and the absence of this grain, in the present instance, was accounted for by a large nest of white ants, discovered close by. No inscriptions or sculptures of any kind were found; and the terra-cotta vessels, though essentially differing from anything now used in India, do not indicate a superior degree of refinement. Capt. Newbold compares these tombs to the Druidical remains of North-Western Europe, and the mounds of the vast Tartarian steppes; and, above all, to the mysterious tombs of Circassia, which are absolute fac-similes of those of India, including their circular aperture. He considers that these widely-separated vestiges of the same family of the human race form a strong link of the chain of argument, which independently of Holy Writ, conducts the migration of the human race from one central point throughout all the world.

Society of Arts.—The Second Ordinary Meeting for Illustration took place on the 21 ult., at the Society's house. Edward Speer, Esq., in the chair. Twelve new members were on the list for ballot. The first communication submitted was on the Theory of Photographic Action, illustrating the connexion between the photographic agent and electricity, by J. Nott, Esq. He observed "that light is only an attendant circumstance of photographic action, as may be inferred from the fact that one body impresses its image upon another in the dark when brought within striking distance." The real agent is probably electricity, and this hypothesis is supported by the analogy between the phenomena of phosphorescence developed through juxta-posed transparent media of different densities or electrical affinities, and those produced by the action of light reflected with different intensities upon a sensitive surface: and some parts of the surface then exhibit elective affinities while others do not. These phenomena could only arise from simultaneous electric attractions and repulsions. Colour not being a property of matter, but of light, all bodies being visible only by reflected light, the tints varying with the position of the spectator with respect to the plane of reflection, the colour as well as contour of bodies should be capable of being taken down. Mr. Nott, with this idea, exposed sensitive surfaces to light reflected at various angles of incidence from the plane of the picture, and as in nature, the local tints of the bodies represented varied with every change of angle, the direct ray giving less picturerque effect than when the parallel glass was used.

These results promised some remarkable effects from polarized light, and a small sun-dial was made, the style of which was formed by a bit of very fine silver-wire, and from the centre of the dial a bit of the same wire was erected perpendicularly, so that the hour angle and the sun's azimuth were given at the same instant. By means of this instrument, Mr. Nott determined with some accuracy the position of the sun with respect to the plane of the picture which he wished to take a photographic representation of. The glass of the camera was also placed at various angles of incidence from the plane of the picture, and as in nature the local tints of the bodies represented varied with every change of angle, the direct ray giving less picturesque effect than when the parallel glass was used.

When by these means the light was polarized into the camera by a double reflection from the plane of the picture, and from the parallel glass he found that the objects in deep shadow and those in sun-light were taken down simultaneously and with equal precision, and without the slightest trace of solarization; exhibiting a sun-light view of the greatest truth and beauty, in which the transparency of the shadows, and the effect of distance were produced by an exquisite gradation of tint. This result of polarized light seems doubly interesting since the recent and beautiful discovery of Faraday, where a ray of extinguished polarized light is restored by electricity.

The second paper was by Mr. Page on the Oil Integument. This is a skin of paint which can be finished in the workshop, and cemented when required, without the inconvenience and delay attendant upon painting in houses. One side of a sheet of fine stout paper, rather larger than the skin required is prepared with a mixture of gum arabic, treacle and water, upon which, when dry, a coat of paint is put, made with boiled oil and white lead in the ordinary way; when dry, the operation is repeated till the skin is of the required thickness; two coats being found to be sufficient for general use. To separate the skin from the paper, it is laid on a clean board with the painted side downwards, the paper is then wetted at the back with clean water, and after it has stood a few minutes the paint may be removed without difficulty. The same paper may be painted on thirty or forty times. The skin, where removed, is carefully wiped with a sponge and dried with a wash leather to remove the preparation; it is then folded and put aside till required. The skin is fixed by rubbing down the surface to which it is to be attached, with pumice stone, and when clean it is gone over with a smear of boiled oil and gold size, the skin is then laid on with a soft cloth as in the ordinary paper-hanging.

Institute of British Architects.—*Jan.* 12.—H. E. Kendall, Esq. V.P. in the chair.—A paper was read by John Britton, Esq. descriptive of Roslyn Chapel, near Edinburgh. This edifice was commenced in 1446, and the widow and successors continued the works, which had been left unfinished at the death of the founder in 1479. Mr. Britton observed, that his attention had been directed by Mr. David Roberts to the aisle at the east end, which is wider than the other; and it would appear that the plan had been changed after the stone-work for the vaulting was prepared, and in order to make it available, the architect had resorted to the expedient of carrying the arches upon large projecting corbels,—a remarkable feature in the construction, which it would be difficult otherwise to explain.—Mr. Burn observed, that the picturesque tradition of the interment of the Sinclairs, shrouded in their armour and uncoffined, in a vault beneath the chapel, is destitute of foundation. There is a crypt, not under, but beyond the chapel, to the eastward, which Mr. Burn believes, on a careful examination, never to have been used as a sepulchre; and there is only one other small vault, where some of the family have been deposited in oaken coffins. Mr. Fowler observed, that the nave of the building was vaulted on the uncommon, though not singular principle of a solid roof, the extrados of the arch forming the external covering. The vaulting of the east end aisle is remarkable for its excessive flatness, and appears to have been retained in its place by iron ties grooved into the stones—a singularity in the construction of the Middle Ages. Mr. Donaldson read a letter from Mr. Knowles, from Athens, describing some late discoveries made in further disencumbering the Acropolis of its rubbish. One result has been to ascertain, that the interior of the Parthenon was supported by columns of the Doric order, three feet seven inches and a half in diameter, of which the fluted contours remain traced on the pavement.

PARIS ACADEMY OF SCIENCES.—*Jan.* 12—A paper was received from M. Matteuci, of Pisa, relative to some experiments which he has made on the railroad from Milan to Monza, for the purpose of deciding between two opposite theories as to the conductibility of the earth. M. Matteuci inclines, from these experiments, to the opinion that the earth does, by its mass, present a full compensation for the non-conductability of its nature.—A communication was made by M. Letellier on the preservation of wood. M. Letellier states that, so long ago as 1837, he pointed out the means of preparing wood by immersion, first by impregnating it with deutochlorure of mercury and then with gelatine, which rendered the mercurial salt insoluble, and, in December, 1840, he pointed out the disadvantages of the use of pyrolignite of iron, as recommended by M. Boucherie. A communication was made by M. Payen, in the name of Dr. Turnbull, of London, relative to his process of tanning, and also the application of the soluble principle of sugar to the same purpose. A commission of the Academy consisting of Messrs. Payen, Boussingault, Dumas, and Dutrochet was appointed to visit the tan-yard, where experiments were going on, and to make its report.—A paper was received from Messrs. Paul Desains and De la Provostage on some experiments respecting the laws of refrigeration of gases under pressure. They confirm what has been hitherto published on this subject, and show that the refrigeration is more active when the gas is in a large than a small vessel, even though the pressure be not so great.—A letter was received from M. Lecoq, in which he shows the possibility of cultivating the tea-plant in France. M. Lecoq states that he is able by his mode of preparing tea grown in France to produce as fine qualities as the best that are imported from China. He has forwarded samples to the Royal Society of Agriculture.

ARCHÆOLOGICAL INSTITUTE.—*Jan.* 9.— Sir Richard Westmacott called attention to some beautiful Italian sculptures in ivory, which had passed into his possession from the collection of Flaxman, probably representing, in a series of groups, the incidents of some legend or mediæval romance. They appear to have been exeented in the beginning of the fourteenth century, and afford a remarkable example of a peculiar style of design, considered by foreign antiquaries to be Venetian, and of which there are specimens in the Musée Charles X. at the Louvre, and in private cabinets on the continent. He also exhibited a head sculptured in stone, of the 14th century, from Hereford Cathedral, remarkable for the fine character of the features and expression.

The Marquess of Northampton exhibited a bronze Etruscan vase, of unusual form, found at Bomazza, and a mirror ornamented on the reverse with an engraved group of the Judgment of Paris; and a number of beads formed of vitreous pastes, discovered near Rome, resembling the beads found in British barrows.

Several interesting primeval weapons of flint and bronze, discovered in Glamorganshire, belonging to the museum of the Royal Institution of South Wales, were exhibited. A valuable illustration of these remains was contributed by Mr. J. Winter Jones, consisisng of lance and arrow heads of silex, discovered in Canada, which Mr. Birch remarked, closely resemble in form and adaptation the weapons of the primeval tribes of Great Britain and Northern Europe.

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## ART. XI.—NOVELTIES IN ARTS AND SCIENCES.

*Egyptian Antiquities.*—The important Prussian expedition under Professor Lepsius, which has for the last three years been engaged in antiquarian researches in Egypt, has now returned to Berlin with a vast amount of materials, consisting of twelve hundred drawings of monumental antiquities and collections of works of art, either purchased by M. Lepsius, or presented by the viceroy to the Prussian monarch. The materials thus accumulated, are now in process of arrangement for publication, and much light is expected to be thrown by them upon the early history of the human race. Dr. Bethman has devoted considerable attention to the chronology of Egypt, and has obtained some data which may tend to elucidate the Arabic origin of the gothic system of architecture. The researches of Dr. Lepsius have been very accurate and systematic, and have left no part of the Nile's banks unexplored which was likely to elucidate any point of inquiry, with the exception of the Lower Delta; which, from the periodical inundations, and the deep deposits of alluvial strata is attended with great difficulty and expense. The chronological order of Egyptian monuments from the shores of the the Mediterranean upwards, and their conuection especially with the Ethiopic era, have received considerable attention: and the investigations respecting the monumental hieroglyphics will prove of great interest from their intimate relation to the origin of languages, and of the art of writing. Among some of the more immediate results of the expedition, we may mention that the position of the ancient lake of Mœris, respecting which much dispute has arisen, has been accurately determined: the Labyrinth at Fajum has been discovered; the tombs adjacent to the Pyramids have been examined and explained, and those stupendous fabrics have been restored, and a theory of their erection promulgated; drawings of the Memnonium at Thebes have been made; another copy of the Rosetta stone has been discovered at Phylä; and the inscriptions on the heights of the Nile at Semne have been deciphered. The history of Ancient Egypt is closely entwined with the history and progress of civilization and the arts; and a more extended and accurate knowledge of its antiquities cannot fail to enlighten us on many points which have hitherto been enveloped in obscurity, and much valuable information will, in all probability be elicited on a careful digest of the materials now secured by the liberality of the King of Prussia.

*Transmission of power by Atmospheric Pressure.*—Mr. Armstrong, of Newcastle, has recently read a paper there, pointing out the advantage of husbanding the mechanical power of streams running to waste, by the erection of suitable dams and reservoirs, to the end that water may be brought into towns in pipes under a high pressure for the accomplishment of the various mechanical operations, for which the steam-engine is at present employed. The suggestion is one worth attending to; but it appears to us, that instead of water it would be preferable to employ air as the transmitter of the power, which would be attended with fewer inconveniences, and would not involve the use of such costly pipes. It is not, however, from streams alone that we would seek to derive mechanical power, but we would make use of the rise and fall of the tide, and the currents of the atmosphere, as sources of power, by causing wind-mills and tide-wheels or screws to compress air into pipes or exhaust it from them, and by the use of capacious receivers, a steady motive force could thus be obtained from powers the most capricious and irregular. In Woolwich dockyard, a punching press is driven by a small engine worked by atmospheric pressure, and other cases might be referred to, in which a shaft has been superseded by a pipe, but this principle of transmitting power has not yet met with the favour and adoption it will one day receive.—All machines may be turned by natural power, household tasks performed, fields ploughed, and corn thrashed and reaped, and Utopian as all this may seem just now, it is nevertheless certain that it will be done.

*Model of the Parthenon.*—Mr. Lucas's model of the Parthenon is now uncovered for the inspection of the public. It is a very elaborate work, every detail of the edifice being introduced in its due proportions; and the whole of the original sculptures are given in all their integrity, so that the spectator may acquire a just conception of the splendours of the ancient edifice. The subjects of the pediments are—in the eastern, the advent of Minerva; in the western, the victory of Minerva in her contest with Neptune for the territory of Attica, and the drawings of Carrcy, made when the latter pediment was nearly perfect, have enabled Mr. Lucas to reproduce this group as originally composed. The metopes and friezc have been restored with great exactitude, and the gilded shields have also been introduced with the inscriptions between them. The interior of the temple has been restored with similar fidelity. The model is about twelve feet long by six feet wide, and is a beautiful, as well as an interesting object.

*The Planet Astrea.*—The new star of which we gave in our last number a slender account, turns out to be a planet, and has received the name of *Astrea* from Encke, to whom the discoverer, Herr Hencke, of Berlin, conceded the honour of naming this new member of the sidereal family. Herr Hencke had remarked, amid a group of stars of about the ninth magnitude, one not marked on the latest celestial map; and, a few days afterwards, saw that its position, in relation to the neighbouring stars, had changed. His first conjecture was that it might be a comet; but the absence of tail and nebulosity led him to the subsequent conclusion that it was a planet. This view of the matter has since received confirmation. The new star has been observed at Berlin, Altona, Hamburgh and Paris; and it seems now agreed that its dimensions are those of a star of the eleventh magnitude, not the ninth, as first stated. Its actual volume is compared to that of the four smaller planets already known, Juno, Vesta, Ceres and Pallas.

*A Burning Well.*—M. Wannemaker, of Ohio, lately sunk a well to a depth of twenty-four feet, and continued sixty-seven feet seven inches beyond this by boring. The bore passed through clays in some parts containing selenite, and at bottom reached a coarse sand, resting upon a rock, probably sandstone. Upon striking into the sand, carburetted hydrogen gas rushed up by the sides of the auger-rod with a shrill whistling noise, upon which the workmen left the wheel and withdrew the drill. They experienced no difficulty in breathing, and can now descend into the pit without inconveuieuce. One of the workmen, thinking it might be inflammable gas, lighted a lamp with the intention of lowering it, but did not have the opportunity; for no sooner had the match been kindled, than the whole took fire and blazed up to the height of twenty feet, with an explosion that was heard to the distance of three quarters of a mile. Two individuals were scorched and somewhat injured by the explosion. After the first explosion the gas continued to burn at the bottom of the pit for twelve days before it was extinguished. Since this occurrence, which happened on the 17th of July, the gas has continued to issue without abatement, and is frequently set on fire for the amusement of visitors. Similar phenomena occur in nearly every part of the world in which there is bitumenous coal.

*Artificial Asbestus.*—A specimen of this substance has been found in a blast furnace, imbedded in the matter which had collected at the bottom of the furnace in the course of two years and a half, and which is technically called the hearth; it was in a cavity, about eight inches below the level on which the liquid metal rested, and was interspersed with distinct and beautiful crystals of titanium. In all its general characters, this substaece corresponds with asbestus. It is colourless, inodorous, and tasteless—and occurs in small masses, composed of extremely minute filaments or fibres, cohering longitudinally together. These fibres are very easily detached from each other—and are flexible, though not so much so as the common asbestus. They have a silky lustre, and are unattacked by sulphuric, nitric, or muriatic acid.

*Egyptian Hieroglyphics.*—A communication has been made by Mr. Birch to the Royal Society of Literature, on the subject of the Egyptian obelisk in the At-Meidan at Constantinople, which throws light upon the annals and chronology of Egypt, in connection with Bible history. The hieroglyphics record the fact, that Thothmosis III., the erector of the memorial, who reigned 1736 years A. B., has pushed his conquests as far as Naharaim, or Mesopotamia. The monolith shrine, commonly called the sanctuary of Karnac, which is now in the Louvre, is a monument of the same reign; and Mr. Birch announced that he had examined the copy of the long hieroglyphic inscription which covers it, published by the society in 1823, and had found it to refer to the same transaction. He also announced the important fact, that he had found there the names of the two chief cities of ancient Mesopotamia, Babylon and Ninevah. Mr. Osburn explained that another foreign name, occurring in the inscription on the sanctuary, written in hieroglyphics by the consonants *r*, *d*, and *n*, he had ascertained to be that of the founders of Aradus, an ancient city of Phœdocia, situated on the Mediterranean to the north of Tyre.

*Barbadoes Coal.*—The following analysis of the bituminous coal found in various parts of the island of Barbadoes has been made by Mr. Herapath, of Bristol:—"The specimen of coal sent me for analysis contains, in 100 parts. as follows:—

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|---|---|
| Bitumen, resolvable by heat into tar and gas | 61.6 |
| Coke ... ... ... ... ... ... | 36.9 |
| Ashes... ... ... ... ... ... | 1.5 |
| Sulphur ... ... ... ... ... | none. |
| | 100 |

The large proportion of bitumen, in comparison to the coke or carbon, will prevent this coal from being used as a common fuel, unless some means are taken to remedy the inconvenience; it should be mixed with some substance more fixed in the fire, and consequently capable of longer endurance in the heat. Hard charcoal, more refractory coal, and even perhaps earthy substances, would be beneficial. If it could thus be made to give a more solid heat, there is nothing to prevent its being made use of generally, as the ashes are in very small proportion, and it contains no sulphur.

## Art. XII.—NOTES OF THE MONTH.

*Design.* Mr. George Wallis, the head master of the Manchester School of Design, has, in a letter to the Council, put forth some views respecting the means of training up skilful designers, which are well worthy of consideration. The first step in his proposed plan of instruction to habituate tbe pupil to the accurate formation of simple geometrical forms, and the second to give him some practice in their combination so as to form outlines of simple objects. Next comes instruction in shading.

Those students to whom a knowledge of the human figure is essential in their future practice, as decorative painters, carvers, general engravers, &c., form tbe first section, and are taught to shade in cbalk, by diagrams of flat tints, and afterwards by exercising them from the lithograph on white, and afterwards on tinted paper; and as a preparation for drawing from the large examples of the ornamental cast, each student executes a drawing enlarged from the copy, as an evidence of bis power to judge of proportion, as wcll as size and form.

The second section is composed of those students who are already, or may intend to become, designers for calico prints, silks, and other woven materials. These are taught shading by means of Indian ink, in the first instance from the flat, and afterwards from the cast; this method being peculiarly appropriate to their future pursuits, as giving them an early and valuable power over tbeir instrument, the brush.

The next step is instruction in the human figure. Here the student sets out with the bones as a foundation, and next proceeds to the muscles, after which the full finished bust becomes his model. He goes on through the figure—trunk arms, legs, hands and feet, until he studies the complete figure from the antique statue. These acquisitions are all preliminary. Next comes the art of design, and here we shall let Mr. Wallis speak for himself:—

"For the purposes of education, design may be divided into two parts, —that which is based upon a knowledge of the construction of conventional ornament, as practised in the various epochs of art—and that which is founded on nature, through an investigation of its most obvious principles, and the best means of adapting these, conventionally, to the purposes of the artist. The latter is obviously the only true source of originality, altbough the former may be regarded as tbe source of our conventional use of nature; and any plan for teaching the principles, or, in other words, leading the student to tbink for himself, should be based on careful deductions from these two sources, and in this class every student ought to complete his course of study. It may also be made available for the advancement of early beginners, by giving them occasional demonstrations of the principles on which the elementary course is based. The full course for design is divided into five sections, in order to facilitate the education of the upper classes of students, for whose instruction it is more particularly established. The first section comprises an analysis of the principles of natural form, according to my own views and the ideas of tbe best authors I have been able to render available on this subject; applying these to the composition of ornament, and the illustration of the various leading principles in every style of art. During this sectiou each student is required to produce a design for some positive purpose, based upon the particular principle or principles which form the subject of the lesson or lecture, the illustrations being drawn in tbe presence of the pupils on a demonstration board. One week is allowed for the execution of the prescribed design, when each drawing is produced, enlarged on the board, and criticised in a kindly spirit in tbe presence of the whole class. The results, as you are well aware, have been, so far, highly satisfactory. The second section will comprise the consideration of the generic styles of art, as Hindoo, Egyptian, Greek, &c., tracing, as far as possible, one style out of another, and comparing them with their original types in nature, investigating and adapting them to the purposes of the artist, giving the history of each epoch, and, as far as possible, illustrating the spirit in which the artists of the period wrought by a consideration of the influences at work around them. The third section of this course will be to take either correct drawings of flowers and plants from nature, or, when possible, the originals themselves, and demonstrate various methods of conventionalising them on certain fixed principles already laid down; reducing the design to some prescribed form or proportion such as is usually required in the adaptation of nature or abstract ornament to the positive purposes of the artist or manufacturer. The fourth section involves tbe application of the human figure and animal life generally to the purposes of the ornamentist, illustrated by a reference to the leading points in the comparative anatomy of each, and showing the readiest, most efficient, and most tasteful modes of combining them with foliage. The last section will comprise illustrations of all the general principles of art, as found in nature and the works of the best masters, ancient and modern. Such principles, in short, which, when thoroughly understood, constitute what is usually known as *good taste* in art. This may be called the historic section."

*Trial at Law respecting Screw-Propellers.*—An action has been brought by Mr. Back, Secretary of the Screw-Propeller Company, against Mr. Steenman, for an alleged infringement of Smith's patent for a screw-propeller, of which the company have become the proprictors.

The Solicitor-General, Mr. Martin, and Mr. Webster, appeared for the plaintiff; and Mr. Jervis, Mr. Peacock, and Mr. Prentice conducted the case for the defendants. It was stated in the course of the trial, that notwithstanding a variety of patents had been taken out for the propulsion of ships by tbe screw, not any of the patentees had succeeded in accomplishing their object with anything like success until the application of Smith had been fully carried out. The peculiarity of this last invention was that of fixing and working the screw in tbe centre of the "dead wood," whilst in other plans the screw was proposed to be worked abaft the stern-post or on the sides of the vessel. It happened, however, that in his original specification, whicb had been enrolled in November, 1836, Smith had set out that his patent would work a screw of two turns, but that during an experiment shortly after the Christmas following, he discovered that the vessel had gaiued additional speed in consequence of one turn of the screw having been broken off. Upon this discovery, Smith deemed it necessary to put in a disclaimer of the patent for the *two*-turns screw, and then alleged his patent to be for a screw with *one* turn or *two-half* turns, but still applied and worked in the "dead-wood." A number of experiments and trials of this plan of Smith's were subsequently made, and at length it was admitted by all parties associated with nautical affairs to be successful, and to be superior to the ordinary way of propelling a vessel by paddles. The result was, that Smith's plan was adopted by her Majesty's Goverument, and several of the company's sbips were fitted up with it. Some time since, however, the company ascertained that the screw had been applied to three ships belonging to the Government, namely, the Rattler, the Phœnix, aud the Terror, by the defendant, who was an engineer at Woolwich, and it was contended that the mode in which the application had been made was an infringement of Smith's patent. Hence the present action.

The defendant put seven pleas ou the record: first, that he was not guilty of an infringement; second, that the patent as alleged had not been granted to Smith; third, that Smith was not the last and true inventor; fourth, that the invention, if any, was not a new invention; fifth, that the invention was not a new manufacture within the meaning of the act; sixth, that Smith had not duly enrolled the specification; and lastly, that the invention was a useful invention. The case mainly turned upon the qnestion as to whether the mode by which the screw had heen applied to the ships named could be held to be in the "dead wood."

A number of witnesses for the defence were examined, who stated that so far from the screw heing fixed on the "dead wood," it was fixed ahaft the stern post, in accordance with the specification of a patent known as Camereaux's Patent. Several other patents were also put in, to show that Smith's was not an original invention of the screw. One was a patent, taken out in 1794, hy Littleton; another was that of Camereaux's, in 1828; and a third was Woodcroft's, in 1832, all for a screw to propel ships. An objection was also taken hy the learned counsel for the defendant to the sufficiency of Smith's specification, which point was reserved hy the learned judge.

The Lord Chief Baron, in summing up, called upon the jury to find a verdict upon each issue, remarking that upon the evidence, if the view he had taken of the law of the case was correct, the plaintiff was clearly entitled to a verdict upon all the issues, except the first, that which involved the question of infringement; with regard to that issue, they would apply the testimony they had heard to the point, and then say whether there had heen any infringement hy the defendant. The great question was, whether, where a vessel had been lengthened out beyond the ordinary "dead wood," as in this case, and had had the screw fixed into that elongated part, that application could in truth and fairness be considered as a violation of Smith's patent.

The jury retired at half past seven o'clock, and after a short ahsence returned, finding, first, that the screws in the vessels named were not fixed and worked in the "dead wood;" and second, that there was not a colourahle evasion of Smith's patent in the mode hy which the screw was applied to the said vessels. The Lord Chief Baron then directed that the verdict should be entered for the defendant on the first issue, and for the plaintiff on all the others, giving leave to move upon the points reserved.

*Failure of the Barentin Viaduct.—Rouen and Havre Railway.*— The construction of railway works seems to have fallen almost entirely into the hands of English engineers in many continental countries; and in France, which hoasts of so large au amount of skill in civil and military engineering, this preference of foreigners must excite some jealousy, and render circumspection necessary to obviate any occasion of reproach. The Rouen and Havre Railway is oue of those lines which are under English supervision, and the recent failure of a viaduct at Barentin, as might have heen expected, has given rise to some prejudice against the engineer and contractors. As usual, there is some difficulty in arriving at the real causes of the accident, but the facts of the case appear to be these;—Barentin is a small town ahout twelve miles from Rouen, situated in a valley, through which flows the stream of Sainte Austreberthe. The passage of this glen is effected hy a viaduct of ahout five hundred yards in length, which is supported upon twenty-seven semicircular arches of fifty feet span. The height of the piers varies with the depth of the valley, and at the centre is about one hundred feet, the thickness heing four metres. The foundations and bases of the piers were of stone, carried up to a uniform height, and resting either upon the solid chalk or piles driven into the alluvial deposit in the bottom of the valley; all the rest of the structure was of hrick, made in the neighbourhood; and the arches were, as usual, made in distinct brick rings.

Between two and three hundred men have been employed upon the viaduct, from the spring of 1844 till very lately, when the number was reduced to ahout forty. Four or five arches at the Rouen end of the viaduct have only been completed ahout two months, and it is there that the disaster is said to have originated.

The operations of loading the viaduct with hallasting preparatory to laying the rails was in progress, and had heen carried as far as the fifth or sixth arch which was one of those recently completed. Early in the morning, before the workmen had returned to their lahours, the hricks were ohserved to fall from the arch which had heen last hallasted, and one arch having given way, the whole structure fell down like a ruined house of cards. In consequence of the fall heing thus regular, none of the adjacent dwellings were injured with the exception of a mill, which was situated under one of the arches, the keeper of which fortunately escaped without any material injury. The river blocked up hy the ruins flooded the adjoining lands, and when restored to its channel, the fish below were destroyed in great numhers hy the impregnation of the water with lime. The total loss to Messrs. Brassy and Mackenzie, the contractors, is said to exceed fifty thousand pounds; hut as much of the materials may he again used, this may he overrated. The French papers attrihute this accident to the use of inferior materials and the insufficient size of the columns. They allege that the bricks were of a kind liable to split hy pressure or the action of frosts, and to crumhle away with moisture; and that the mortar was not properly mixed. It is confidently stated on the other hand, that the bricks were hard and good, and that the sole cause of the failure was the undue rapidity with which the works were carried on in wet weather, whereby the mortar was weakened before the application of the concrete, and remained unset, and the unequal ballasting coming upon the unstahle arch occasioned its destruction and that of the whole fahric. There was no indication of weakcess except in the stone foot courses of the piers, where some cracks were visihle, and this lends some countenance to the opinion of the insufficiency of the columns, aud this view is held by the resident engineer.

*Naval Architecture.*—Mr. John Fincham, master shipwright of Portsmouth dockyard, delivered a most interesting lecture upon shiphuilding, showing that science, uncoupled with experience, was not sufficient to form a good naval constructor, and that the greatest care should he taken that one good point in a ship should not be made at the expense of others. The lecturer proved that the French have not advanced in the science of naval construction, as shown in the result of the experimental trials between the English and French squadrons in 1832; hut he also showed that for upwards of a century past our best ships have been huilt after French models; that no improvement in any essential quality had heen exhibited in our mode of construction since the last war with France, and that some of the ships of 1790 were better than those now constructed by us. The restrictions to which constructors were confined previous to 1832 might, he said, account for the slow progress made up to that time in comparison with the French. Mr. Fincham instanced La Gloire, Pomone, Transit, the Dart and Arrow, the Cornwallis, huilt in the East Indies—a good ship—in support of his opinion; and showed by models and diagrams before the audience, that fastness of sailing depends upon other elements than the form given to the vessel. The Caledonian and Victory in their time, with the armaments and complements they carried, were excellent ships, as were the Endymion, Camhrian, and Castor, built in 1797. Mr. Fincham very graphically illustrated hy diagrams the cause and effect of ships rolling, and proves that speed in sailing does not depend upon extreme sharpness or extreme fullness, as, when the ship is in a heavy sea, those hodies are placed in different positions. Mr. Fincham alluded to Admiral Hayes's Inconstant as a beautiful model and perfect ship, and said stability was one of the most important elements of a ship, and as regards stability, that quality depends much more upon sails than we are aware of; that fast sailing depends entirely upon the trim of the ship, and the trim of the sails. One case in point Mr. Fincham knew of, where two ships were recently competing in a trial of sailing: if hoth had attended to the hracing of the yards, the result would have heen equality; whereas one did attend, and the other did not to that important feature in seamanship, and consequently one was considerably beaten by the other. If we carried on experiments with a view to scientific purposes, we should, in Mr. Fincham's opinion, attain much more excellence in naval architecture.

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## ART. XIII.—LETTERS TO THE CLUB.

*Naval Engineers.*—I would that some abler pen than mine would undertake the task I am about to attempt, as in my opinion it is of vital importance to the exertions now in progress, for the purpose of hringing the most remote countries in the world within only a few days of each other hy means of the steam-engine. I read with much pleasure in an early numher of the *Artizan*, an article headed "How to make a steam-hoat pay:" wherein the writer lays down some very good rules, and gives to private companies most excellent advice, and such as no person connected with steam navigation can safely despise; hut I am sorry to see your rules are not generally acted upon. I will pass over the first part of the article, and content myself with a few remarks respecting the engineer's department, which I am sorry has not been rendered respectable in a corresponding degree with the improvement of the engineers themselves; for I find them still at the caprice of captains and officers, subjected to petty annoyances, which ought not to he felt hy persons on whom the safety of the ship and lives of crew and passengers immediately depend, and who, on every principle of equity, ought to rank only inferior to the captain. I have heen led to address you from some late attempts at oppression which have come to my knowledge towards good men who have filled their situations in a most efficient manner, and, indeed, have more than once heen rewarded for meritorious conduct; and my conviction is, that until the engineer is subjected only to such laws as a sense of justice inspires, the great interests of steam companies must suffer either directly or indirectly to a serious extent. What must he felt by an engineer, who, after a long voyage, goes on shore to see his family and friends, on heing called up in the presence of some of the juvenile aspirants to the quarter-deck, hy his commander, and told that he must ask permission of one of these young exquisites before he goes on shore for the future; the Merchant Seaman's Act heing read over to them, that he may he duly terrified with its thunders!

I am sorry that these abuses have not been more prominently hrought hefore the artisans of our great country. The class of steam-hoat engineers of the present day are not what they were twenty-years ago. At that time, it is notorious, they were not such men as ought to have had charge of life and property; having been for the most part unskilful and disorderly; inasmuch as the act of steam navigation heing new, few respectahle men would then leave the workshop to go to sea. A complete revolution, however, has now taken place; yet marine engineers are still treated with the same distrust and discourtesy as if they were the same reprobates as their predecessors. The commanders have been gradually advancing in the respectability of their situation, while the schoolmaster has been enlightening the engineers, until, perhaps, a better set of men cannot be found in any other class; yet they remain the same parish caste that in estimation they were originally in fact. Some years ago the English government issued an order that all steam commanders should study the theory of the steam-engine, and make themselves conversant with all its parts; to the intent of raising up a new class of engineers, whereby they would cease to be dependent upon the present generation; and several naval officers who aspired to the coveted proficiency, articled themselves as pupils to some engineering establishments: but I have not heard of any beneficial results that have arisen from the scheme; and it certainly appears to me the easier achievement to get engineers, whose respectability may be trusted, than to get naval officers of a greater knowledge of steam machinery than suffices to make them dangerous. Naval officers of sense will soon discover, that to acquire a competent knowledge of steam machinery is a far harder theory than to take sights of the sun, or to master the elements of navigation; and will desist from acting upon their own information, which at best must be vague and superficial. If, however, it be deemed indispensible that steam and nautical knowledge be united in the same individual, it would be a much more feasible scheme to make captains of the engineers, than engineers of the captains. The change is indisputably the far easier of the two; and there are few engineers who could not acquire in fewer days than they have been years at their trade, all the extra knowledge necessary to qualify them for the performance of such a function. In the hour of danger, most of the responsibility generally falls upon the engineer; and as your pages can testify, there are cases occasionally occurring, in which, to the engineer, is alone due the salvation of the ship. His mechanical knowledge is a never-failing resource in every emergency; and he can act with all the decision and coolness which arises from the consciousness of such a possession.

As a subscriber to the *Artizan* from its first appearance, and an admirer of the many good articles it makes public, I shall be gratified, should these few remarks be thought worthy a place; and I have no doubt many of my brother engineers will, in such cases, follow the subject up with more ability than I can pretend to possess. Ralph Allen,

*Alexandria.* Engineer in the Service of His Highness Mehemet Ali.

[There is something radically vicious in the system still pursued in the navy, of ranking engineers below mates and midshipmen and other understrappers; and the system must be altered unless the Admiralty is content with the alternative of bringing ruin upon our steam marine. It will never do to put nautical amateurs in charge of engines, and if engineers must be had, the terms of their admission it is clear should be such as will not deter good men from entering or continuing in the service. The great demand for engineers at the present moment raises skilful and respectable men to a premium, and those answering to that description cannot be retained in the navy unless the present regularions be altered, as they can do better elsewhere. For several years past the engine manufacture has been in so depressed a state that engineers have been obliged to take what they could get, and they have had therefore to endure much indignity, though all the while with suppressed impatience. 'A change has come over the spirit of the times' however, and engineers are now in great request, so that unless the navy chooses to bid for their services at a reasonable rate, it must lose all who are worth retaining. The concession is an easy one and entails no heavy expense upon the country, for all that is wanted is the elevation by the engineer to a rank answerable to his responsibility, which may secure him against the vexatious interference he at present suffers.. The objection will no doubt be raised that engineers are not gentlemen, and that they would only awkwardly become the quarter-deck, but we take leave to insinuate that it is not gentlemen in the vulgar acceptation of the term the country requires on the quarter-deck, but men of sense and energy, who are equal to their duty. Those who raise this objection to the concession the engineers desire would have doomed Watt to a life of indignity because he had laboured in a work-shop, or Rennie, because he had been a working mill-wright, or Telford, because he had been a poor stone-mason.

These men nevertheless raised themselves to a position in the world, as many engineers now in the navy will probably do, but if hindrances be set upon all advancement, by the present regulations, engineers must, unless those regulations be altered, seek for a sphere where their capacities may be permitted their natural development. If the Admiralty wishes to possess competent and respectable men as naval engineers, it must make changes in the office that competent and respectable men will think it tenable; unless they do this, there will be a general desertion. Some temptation to remain may no doubt be afforded by a considerable increase of pay, but this is a costly palliative, and although it may induce men to remain, it can never reconcile them to the service. The most ardent patriotism must freeze under the disgusts to which they are continually subject: if a war comes they will extort the desired amelioration which having been granted without favour, will be received without gratitude. We think with our correspondent that it would be a much easier thing for a nautical engineer to qualify himself for the command of a vessel than for the captain to qualify himself for the office of engineer. Steam-engine studies have of late been fashionable among the officers of the navy, and this fashion we would by no means seek to discourage, for it would be a most illiberal thing of an engineer to make a secret of his art; and we are convinced his true interest lies, rather in giving information on steam subjects to every one willing to receive it; but we think at the same time, our naval engineers should make themselves masters of navigation, and every other point appertaining to nautical management, partly as a useful and improving study, and partly to humble the paragons of the quarter-deck by shewing that the engineer can out strip them even in their own department.]

Calcutta.—*Caves of Ajunta.*—In my last I think I mentioned the report which was at the time current, that the sculptures in the celebrated caves of Ajunta had been injured by the sweepers set to cleanse them from the soot; but this report has since been contradicted by Capt. Johnson, the local officer, at Ajunta, in a letter, in which he stated that the greatest possible care was taken in cleaning the caves; and that they have sustained no damage from the operation. A Mr. James Fajurner has lately published in London a work on the Rock-Cut Temples of India, accompanied with admirably-executed lithographs of their sculptures, &c., and those of Ajünta are depicted among the rest.

*Railways.*—Mr. Macdonald Stephenson and the engineers who came out from England with him, started about a month ago to survey his proposed line of railway; and are, I believe, now about Allahabad. Their progress, if they purpose proceeding to Furzepore, may, however, be interrupted, as there appears to be every probability of our soon having a battle with the Seikhs. It is greatly to be wished that the Punjaub was reclaimed from its present state of anarchy; and it would be preferable that the progress of the engineers should now be arrested, than that, after active operations had commenced, these descendants of Runjeet Sing should take it into their heads to demolish the works. Mr. Simms, the government engineer, and his party, have also lately left Calcutta to survey the country northward. They kept the left bank of the river, as far as Fultah, about 15 miles distant, and then crossed to the opposite side; their intention being to proceed along the Benares road. It is said that Mr. Simms at present inclines to the idea of carrying a line along the left bank of the river as far as Cutwa, about 120 miles distant; and this, with the view of avoiding the alluvial sands on the opposite side. This plan would involve the bringing of the rivers Mutahangut and Bhagiruttee; neither of which, however, are of any considerable breadth. At first sight it would appear, from the Ganges flowing from the eastward, that the country in that direction would be more liable to inundations than that lying to the westward; but this not the case. The land on the west side of the Hooghly consists of a low plain, and the multitude of streams which run on that side southward through the Sunderbuds, afford some exit for the excess of water during the inundations. When Mr. Simms and Mr. Stephenson arrived from England three months ago, a very serious inundation had occurred on the right bank of the Hooghly, from the river Damooda having broken its banks. This is the third time it has burst its fetters during the last twenty-one years; and this occurrence has suggested the propriety of doing away with artificial embankments altogether. If they are continued, we may probably have the Damooda, in the course of ten years, above the level of the surrounding country. These last inundations committed great havoc throughout the country; villages were swept away, crops were destroyed, and the poorer classes of the population were thrown into the greatest distress. Similar scenes occur every year during the rains, but not, of course, of so serious a character as on the occasion just mentioned, when the water stood at from three to ten feet deep, for 70 miles on the Grand Trunk Benares road. The proposed Great Western Railway of Bengal is not much thought of here. Dwarkanath Tagore, as trustee, may do very well in England, but here it will not do: as the route of the railway is considered highly objectionable.

*Government Assistant-Engineers.*—I have before referred to the intention of Government to establish a subordinate class of civil engineers, with sublime attainments and small pay. The subordinates are to be styled *Sub-Assistant Executive Engineers*, and they are to receive a yearly salary of £120, with travelling allowances, when in the field, to the extent of 3-10ths of the salary. The candidates for the situation must first of all understand English—then they must be acquainted with geometry, algebra, plane and spherical trigonometry, conic sections and mechanics. They must understand the use of the sextant, theodolite levelling instrument, &c. and have a practical knowledge of land surveying and levelling. They must furthermore be able to draw maps and plans, and to prepare estimates and specifications. So that it would appear to be the fate of these aspirants for engineering fame—first, to render themselves adepts in a wide field of knowledge, and then to undergo transportation from old England to this torrid clime, for the magnificent sum of £120 a year! I may indeed be wrong in supposing that these sub-assistant etceteras, are expected to be natives of Great Britain, and if it is desired they should be natives of this country, I suspect that there are very few of them who possess physical strength and energy sufficient to undertake the duties required in the field—throwing out of consideration, the penury of their specified attainments.

*The Fire-Queen Steamer* is about to be sold, as her voyages to and from the the Straits have not proved remunerative. It is said she has been offered to a company proposed to be formed at Madras, to run steamers along the coast, as far north as Ganjam and southward to Colombo, touching at the intermediate ports. They will require steamers which draw little water to go through the Pambaun Channel.

*Vessels Building at Bombay*—In the dockyard at Bombay they are now building two packet-steamers of 1400 tons, to correspond with two others building at home. They are also at work on an 84-gun ship, and two brigs, *Goshawk* and *Zebra* for H. M. service. The ship is expected to be launched in January, 1847: the steamers are, I suppose, to be fitted with the engines now making by Scott, Sinclair, & Co. A company at Bombay have purchased, for running between that island and Ceylon, a French steamer the *Victoria*, of 500 tons and 100 horse power which was sent up here from Australia some time ago for sale.

*Inland Steam-Navigation.*—I now hear nothing about the progress of either of our two companies of *inland steamers*. Some time ago the Indian General Steam Navigation Company determined upon having two flats, to be towed tandem by their steamers, instead of only one, but we have not as yet seen either flats or steamers. It has now been proved by experiment that steamers having the lightest possible draught of water cannot proceed with safety much beyond Allahabad. The *Mezna* steamer with a flat in tow (belonging to Government) proceeded up as far as Gurmachteser,* but her progress was tediously slow, not averaging more than 3 miles per hour, and she struck on innumerable sand-banks, and had moreover to take out what little cargo she had for the purpose of lightening her. If it was found to be worth the expense, some of the sand-banks could be removed, and natives could easily be found possessed of local knowledge sufficient to act as pilots. Thus the two more unpleasant difficulties to the progress of steamers about Allahabad might be considerably lessened.

*The Nicobar Islands.*—The Danish government having sold to England their possessions in India, Seranpore, and Tranguebar, have adopted the idea of colonizing the Miobars. They have purchased the *Ganges*, one of the E. I. Company's old sea-going steamers, for £4,500, which has been laid up in ordinary in a river for some months, and have sent her, with some scientific men who came out from Denmark latterly, to those Islands on an exploring expedition.

*Preservation of Copper Sheathing*—A curious circumstance was discovered about three months ago when the *Hindostan* steamer was put into dock. It was found that some chalk marks which had been made on her copper upwards of a year before, retained all their freshness; and the copper underneath these marks had not been worn away, but retained its original thickness. The obvious conclusion from this is, that the chalk had protected the copper; and to ascertain whether such is the case of not, a considerable portion of the sheathing of a vessel lately built here, the *Æneas*, has been chalked over. I shall ascertain if possible, the result of this experiment, and apprize you of it.

*Government Acts.*—It is pleasant to glance occasionally at the acts as printed in the government *Government Gazette*. They are the true index of the feelings and dispositions of the ruling powers—and although the enactments made about a century ago by Governors of India are severaly animadverted upon, it is pleasant to find these gradually overthrown, and the statute-book jostling though not keeping pace with the march of intellect; and it is pleasant also to find, that although our present Governor-General is in the far north and rumours of warfare the order of the day—that such enactments as the following emanate from the Council Chamber. First of all as likely to prove of interest to mechanics,—the duty on machinery imported into India, including plate iron prepared for hulls of steamers, has been removed. The regulation of the trial of alluvial lands has been modified. Every one has heard of the celebrated perpetual leases granted to the natives, by—I think Lord Cornwallis. Until lately Government appropriated to itself all alluvial lands gained; but as there would be of course a corresponding loss to other lands, it made no allowance to the Jemindars, who held the lands upon which losses occurred, and which were now "*waters,*" not lands at all. The new enactment however provides that a re-measurement of the lands will take place at the end of every 10 years, and the land owner shall thus only have to pay for what he actually possesses. Again—the Government has now established a College in Nuddoah, the seat of Brahmonical lore. In this, indeed, they have been greatly aided by the wealthy natives of the district, who give their cordial co-operation to the scheme, and at a meeting they held regarding it, subscribed the enormous sum of £13,000! I question much if at any single meeting in England, composed of three times the number of "inteligent Englishmen" as they were of Muddeah, Kaguhs, and Jemindars, as large an amount would have been subscribed. This of course establishes the College at once, and Government has appointed as principal, Capt. D. L. Richardson, who has obtained a poetical fame for "Sonnets" to various ladies, and who is said to be a talented man.

A great contrast to the above mentioned college subscription, is one attempted to be collected in Calcutta, for the erection of a free college, where Christianity was not to be whispered except to be reviled; Brahminism was to be preserved intact. The subscription for this annually amounted to £3,000; and about ten times this sum was required. Poor Hindooism! this is all the support it can raise from its most staunch and orthodox friends. They were enraged at the success obtained by the indefatigable Dr. Duff in his institution—and this was all the opposition they could bring against him. The men who promised to give £3,000 expected perhaps twenty times this amount during the native holiday in the month of October, in matches, private theatricals, and in feasts, with the professed,—but only the professed—object of doing homage to a mass of tinselled clay. But I am growing prosaic.

*Falling in of the Church Roof at Bhaguepore.*—This is a civil station about 27 miles distant from Calcutta. The building cost £9000; it is 60 feet long, 55 broad, and 30 feet high, exclusive of a tower. It has side aisles, and the roof was supported by massive pillars and pointed arches. The accident has been attributed to the hasty manner in which the church was got up. It was the work of a civil servant of the E. I. C. who it is said drew the plan, collected all the materials, and in 16 months completed the body and nearly finished the tower. The roof fell in on a Sunday, but luckily the people had left the church shortly before the accident took place.

MAC.

ABERDEEN.—Messrs. Simpson and Co. are at present making a set of tubular boilers for the Aberdeen Steam Company, and a set of long-flue boilers for a steamer belonging to Denmark, which Messrs. Simpson fitted out a few years ago. The tubular boilers are mostly taken from your description of those in the *Braganza*, with the exception of introducing water bridges, and making the sides straight instead of having them bent in, they also have a manhole door in the passage between the boilers, to enable a person to get into the water bridges, and water space of the termination flues to clean them. I was lately called to see an engine at Woodside, of the side-lever kind, made by Mr. Fairburn, Manchester. It is about 110 H.P., but not loaded to above 80. You will see by the diagram that the throttle valve is nearly shut by the governor. Now I do not see that the throttle valve acts so well as a cut off valve, as the steam gets into the cylinder all the length of the stroke, and does but little good; whereas, if the steam has been cut off at the point where it crosses the atmospheric line by a cut off valve, there would be no more steam spent for that stroke, and the throttle valve might be opened to let the steam into the cylinder at a higher elasticity; and I think a saving of fuel effected. The steam in the boiler was at 3½lbs. when this diagram was taken; the engine is very heavy on the coal, burning 14lbs. per H.P. of her effective working power. I shall be happy to hear *your* ideas on the subject.

L.

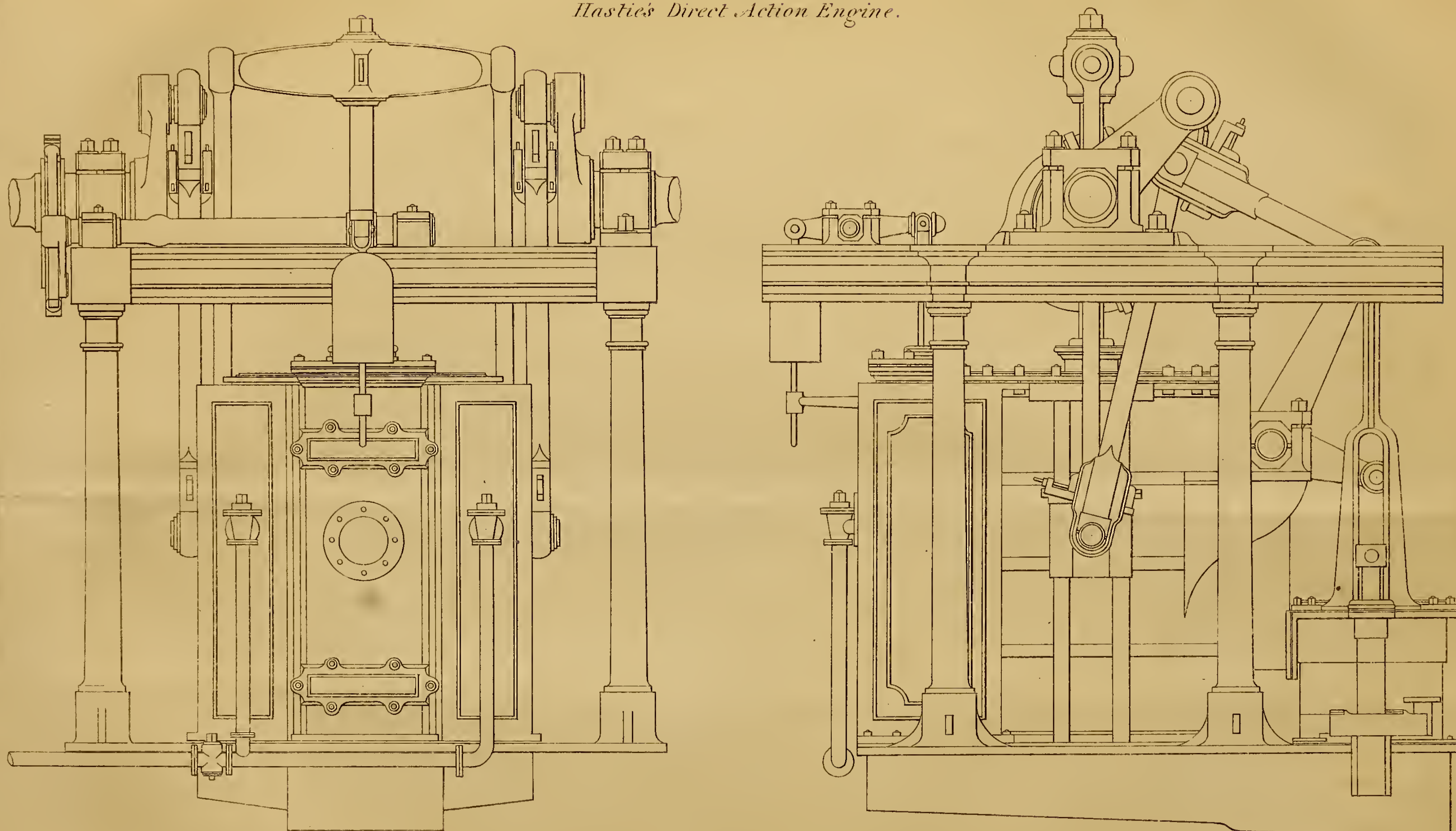
[Partially closing the throttle valve is not a beneficial method of diminishing the consumption of fuel, unless there be lap upon the slide valve; but when there is lap upon the slide valve, closing the throttle valve will make the expansion much greater than it would otherwise be. If, for example, the steam were to be cut off by the slide valve at half stroke, indicator diagram would follow the course indicated by the dotted line in stead of that actually pursued. It appears to us from the diagram that there must be a good deal of condensation in the steam pipes.]

*Gurmachteser Ghat (about 100 miles from Meust, and the highest point to which the large country cargo boats proceed.

Cylinder
54 inches
diameter.

Length of
Stroke
5 ft. 6 in.

Hastie's Direct Action Engine.



F. Mansell. sc.

London, Artizan Club, 1846.

# THE ARTIZAN.

No. XV. New Series.—MARCH 1st, 1846.

## Art I.—REPORT OF THE GAUGE COMMISSION.

The gauge commission has at length made its report. That it will give satisfaction to every party is of course not to be expected, but we believe it to be as certain that it will meet with the approbation of all discriminating and unprejudiced spectators. The report pronounces the existence of a diversity of gauge to be an intolerable evil, and recommends the government to compel the observance of uniformity in all railways constructed for the future. The narrow gauge, it appears, is the one preferred, and the selection is justified by arguments identical with those which we have frequently used upon the same subject, but are urged with greater patience and ability. The report indeed we look upon as a very able production, and even those who dissent from its conclusions must admit that their views have been fairly stated and patiently investigated. High compliment is paid to the genius of Mr. Brunel, upon whom the present decision must come as a heavy blow, and engineers at least will acknowledge that such praise is both opportune and just. If Mr. Brunel has erred, it is probably in having gone too far in advance of his times, and his works appear to look as much to the wants of posterity as to those of the present generation. Though the narrow gauge may be the most suitable now, it may not be most suitable when the intercourse by railway has reached the pitch it will probably attain within the next 50 years. We are now too far committed, however, with the narrow gauge to make retractation possible, and at the present time it certainly appears to be of adequate power for all the wants of the country. The ultimate ramifications of a railway moreover must always have little traffic, and the power of the broad gauge must be needlessly great for such feeble lines.—We must, however, cut these remarks short, as we cannot afford to swell the space the report itself must fill.

### REPORT.

We, the commissioners, appointed by writ under your Majesty's Privy Seal, bearing date the 11th of July, in the ninth year of your Majesty's reign, to inquire whether, in future private acts of Parliament for the construction of railways, provision ought to be made for securing an uniform gauge, and whether it would be expedient and practicable to take measures to bring the railways already constructed, or in progress of construction, in Great Britain, into uniformity of gauge, and to inquire whether any other mode could be adopted of obviating or mitigating the evil apprehended as likely to arise from the break that will occur in railway communications from the want of a uniform gauge, beg dutifully to submit, that we have called before us such persons as we have judged to be, by reason of their situation, knowledge, or experience, the most competent to afford us correct information on the subject of this inquiry, and we have required the production of such books and documents from the various railway companies as appear to us to be the best calculated to aid our researches. We have personally examined into the usual course of proceeding on various railways both at home and abroad, especially those that are incident to a break, or interruption of gauge, and we have personally inspected several locomotive engines, as well as mechanical contrivances invented either for the general use of railways, or for obviating the special difficulties presumed to arise from the break of gauge, or otherwise connected with the subject of our inquiry, and, as we believe we have now carried our investigation to the utmost useful limits, we feel in a position dutifully to offer to your Majesty the following report.

I. Our attention was first directed to ascertain whether the break of gauge could be justly considered as an inconvenience of so much importance as to demand the interference of the legislature. Gloucester is the only place where a break of gauge actually exists at the present time. It is caused by the meeting at that place of the broad, or 7 feet gauge, with the narrow, or 4 feet, 8½ inch gauge. There are other points, however, where a transfer of goods occurs similar to that which must result from a break of gauge, and persons well acquainted with railway traffic have no difficulty in foreseeing the nature of the inconvenience that would arise from any further intermixture of gauge; and we humbly submit the observations that occur to us as to the whole of this important part of the question.

We will divide the subject of the break of gauge under the following heads:—Firstly, as applying to fast or express trains; secondly, to ordinary or mixed trains; thirdly, to goods trains; and fourthly, to the conveyance of your Majesty's forces.

*Fast or express trains.*—We believe that the inconvenience produced by break of gauge will, in some respects, be less felt in these than in other trains, because the passengers travelling by fast trains are usually of a class who readily submit to many inconveniences for the sake of increased speed on the journey, and who are perhaps generally less incumbered with luggage than persons travelling by the slower trains; and as it is understood to be the general practice that no private carriages or horses are conveyed by these trains, the inconveniences of a break of gauge are reduced in this instance to the removal of the passengers and a moderate quantity of luggage; and, although such removal must create delay and some confusion, as well as personal discomfort, especially at night and in the winter season, besides the risk of a loss of luggage, yet we do not consider the break of gauge, in this instance, as being an inconvenience of so grave a nature as to call for any legislative measures, either for its removal or for its mitigation.

*Ordinary or mixed trains.*—In these trains the passengers considerably exceed in number those who travel by the fast trains, and they have generally a much greater quantity of luggage. To such travellers a change of carriage is really a serious inconvenience, and it is a well known fact that persons travelling by railways in communication with each other, but under different managements, endeavour to make such arrangements as to admit of their travelling by those trains which afford them the accommodation of occupying the same carriage from the beginning to the end of their journey. The managers and directors of railways are well aware of this feeling, and in some instances where they do not allow their carriages to run through, yet with a view of diminishing the inconvenience to which this exposes their passengers, they send a luggage van from terminus to terminus, to prevent the evil of a removal of the passengers' luggage; and some railway companies incur considerable expense in running trains of return empty carriages in order to accommodate the public by enabling travellers to avoid a change of carriage on the journey. It is by the ordinary or mixed trains that private carriages and horses are conveyed, and the removal of either from one truck or horse-box to another, at any part of the journey, would be attended with inconvenience and delay; and, with regard to the horses, it would involve considerable risk. We arrive, therefore, at the conclusion, that the break of gauge would inflict considerable inconvenience on travellers by the trains now under consideration, and that this inconvenience would be much increased at points of convergence of more than two lines. The change of carriages, horse-boxes, and trucks, and the transference of luggage of an entire train of much extent, must, even in the day time, be an inconvenience of a very serious nature, but at night it would be an intolerable evil, and we think legislative interference is called for to remove or mitigate such an evil.

*Goods trains.*—From the statements made to us by carriers on railways, and from our own observation, we are induced to believe that not only a considerable degree of care, judgment, and experience is necessary in the stowage of merchandise in railway waggons, but also, that it is desirable that when properly packed the articles should, generally speaking, not be disturbed until the journey is completed. We find that in the arrangement of merchandise, the heavier goods are placed at the bottom, and the lighter at the top of the load, and so secured as to prevent friction as far as practicable from the jolting of the waggons; and it is considered very desirable, with a view to prevent loss by pilfering, that the sheetiug, which is placed over the load, should not be removed till the completion of the journey. Indeed, acting upon this principle, carriers find it profitable to send their waggons partially filled from various stations on the line, thereby increasing their toll to the railway company, rather than incur the risk of loss by theft, to which they would be exposed by uncovering the waggons on the journey, to fill up with intermediate local goods waggons, that may have started with light loads from one of the termini. The stations for re-arranging the goods trains are, therefore, as few as possible; thus, between Leeds and London, the points for unsheeting the goods waggons are only Derby and Leicester; and between Liverpool and London, the re-arrangement is confined to Birmingham and Rugby; and even at those stations the proportion of waggons which are uncovered is very small; indeed, it is stated that at the important town of Birmingham five-sixths of the waggons pass without re-arrangement. In the conveyance of machinery and articles of a similar class, which are both heavy and delicate, it is of the utmost consequence that the load should not be disturbed between the beginning and the end of the journey; a change of carriage, such as would result in all probability from a break of the gauge, would altogether prevent the transport of such articles by this mode of conveyance. We believe that the traffic upon the line of railway between Birmingham and Bristol has been greatly restricted by the interruption of gauge at Gloucester.

In respect to the conveyance of minerals, the inconvenience of a break of gauge would be very serious; the transfer being attended with an expense which would be sensibly felt in consequence of the low rate of tolls charged on such articles; moreover, many descriptions of coal, such as a considerable proportion of that of the Midland Counties, are subject to great deterioration by breakage. In regard to various articles of agricultural produce, the loss by removal would be less than on other classes of goods; much inconvenience, however, would be found in the transfer of timber; and the difficulty of shifting cattle would be so great as to present an insurmountable obstacle to such an arrangement, from the excited state of the animals after travelling by railway, and the resistance they in consequence offer when it is attempted to force them a second time into a railway waggon.

*Conveyance of troops.*—There is another use of railways which we have deemed it necessary to consider; we allude to the transport of your Majesty's troops, with their military stores, &c., either in the ordinary movements of corps through the country in the time of peace, or in the more pressing and urgent case of their movements for the defence of the coast or of the interior of the country. We have carefully weighed the important information given to us by the Quarter-Master-General of your Majesty's Forces, as well as by the Inspector-General of Fortifications, both officers of great experience; and we deduce from their opinions, that although a break of gauge on the line of route would produce both delay and confusion, yet that as in time of peace it is usually practicable to give notice of the intended movements of a body of troops, the inconvenience of the break of gauge might be so reduced as not to be an evil of great importance; but, in the event of operations for defensive objects against an enemy, the inconvenience would assume a serious character.

It would appear, that for the defence of the coast, the proper course would be to retain the great mass of troops in the interior of the country to wait until the point selected by the enemy for his attack should be ascertained with certainty, and then to move upon that point such an overwhelming force as should be adequate to the emergency. It is obvious that the success of such a system of defence must depend upon the means of conveying the troops with great dispatch, and without interruption on the journey. The troops should be carried with their equipments complete in all their details, and with their artillery and ammunition; and it therefore appears indispensably necessary, in order to insure the requisite supply of carriages, where perhaps little or no notice can be previously given, that the whole should be conveyed in the same vehicles from the beginning to the end of the journey. The effect of a break of gauge might, in this view of the case, expose the country to serious danger.

To all classes of merchandise, as well as to all military operations connected with railways, one general remark will apply, that in starting from any one point it is usually practicable to obtain a sufficient number of waggons for whatever may be required to leave that point, however irregular the traffic may be; but, at the convergence of several lines, where the greater number might be of a gauge not corresponding to the gauge of the other lines, if it happened that all were unusually loaded at the same time, it would probably be impossible to provide on the latter an adequate number of waggons to carry off all the loads thus brought; the alternative would be, on the one hand, to submit to great confusion, delay, and inconvenience, on all the converging lines having the majority on the same gauge; or, on the other hand, to maintain on the lines being in the minority a very extensive stock of carriages, which in general would be totally useless.

There is one point which forcibly presses on our attention, and the truth of which must be readily acknowledged, but of which the importance is not at first equally obvious; it is, that the greater part of the inconveniences to which we have alluded are not inconveniences of rare occurrence, and which would affect only a small number of persons, but, on the contrary, that many of them would occur several times in the course of every day to a great number of persons at each point at which a break of gauge might exist. The cumulative amount of such inconvenience would of necessity be very considerable, and we feel bound to sum up our conclusions by stating that we consider a break of gauge to be a very serious evil.

II. We are now brought to the second stage of our inquiry, which is, to discover the means of obviating or mitigating the evils that we find to result from the break of gauge. The methods which have been laid before us, as calculated for this purpose, are as follows:—1. What may be termed telescopic axles; an arrangement of the wheels and axles of carriages, permitting the wheels to slide on the axle, so as to contract or extend the interval between them in such a manner that they may be adapted to either of the gauges. 2. A form of truck adapted to the broad gauge, but carrying upon its upper surface pieces of rail 4 feet, 8½ inches asunder, so that a narrow gauge carriage may be run upon these rails without any disturbance of its wheels. 3. A method of shifting the bodies of carriages from a platform and set of wheels adapted for one gauge, to a different platform and set of wheels adapted to the other gauge. 4. A proposal to carry merchandise and minerals in loose boxes, which may be shifted from one truck to another, and of which only one would probably be carried upon a narrow gauge truck, while two would be conveyed on a broad gauge truck. Of these various methods, the first—if it admitted of being used safely and extensively—would be, in its application, the easiest of all. By the operations of detaching the wheels from one limiting hold, of pushing the carriage along converging or diverging rails until the wheels were brought to the required width, and of then connecting them by another limiting hold, the transformation of the narrow gauge carriage to the broad gauge carriage, or *vice versâ*, would be completed. But this construction is liable to grave objections. It is stated to us as a matter of experience (and we believe it admits of satisfactory explanation), that a very small unsteadiness of the wheels of a railway carriage upon the axle renders the carriage liable to run off the rails. A far more serious objection, however, is that the safety of a carriage, and the whole train with which it is connected, would depend upon the care of the attendant who has to make the adjustments of the axle-slide. It is true that there are other cases, as in the attendance on the switches and signals, which depend upon the care of the person who is stationed to work them: but the circumstances differ very widely. In these cases, the attendant has a single act to perform (or at the utmost, two acts only); he is not hurried, and his whole attention is concentrated on very simple duties. In respect to the shifting axles, the attendant would have to adjust a great many carriages in succession (as there are sometimes a hundred waggons in a goods train), the adjustment must be made hurriedly, and often in the night; and the attendant's thoughts would probably have been partly occupied with the loading of goods and other station arrangements. On the score of danger, therefore, we think that this construction must be at once abandoned. But we think it proper to add, that if even there were no such essential ground of objection, a construction of this nature could not be adequately useful unless it were extended to every carriage which is likely to pass the station where the break of gauge occurs. Under the existing system of interchange of carriages, which is adopted by all the railway companies whose lines communicate, and of which the advantages are recognised in special clauses of the acts of Parliament applying to several railways, carriages belonging to distant railways will frequently be found at the place of junction of the two gauges. This construction, therefore, would lose much of its utility unless every railway carriage were made in conformity to it, that is, unless a vast expenditure of capital, and a corresponding annual expense in replacing worn-out carriages, were incurred even on railways very distant from the break of gauge.

The plan of placing a narrow gauge carriage upon the top of a broad gauge truck has, on the face of it, this obvious difficulty, that a broad gauge carriage cannot be placed in the same manner upon a narrow gauge truck, and therefore, unless not only the broad gauge railway, but also all others communicating with it, be furnished with trucks proper for carrying narrow gauge waggons, and with narrow gauge waggons also, and unless the loads travelling towards the narrow guage be placed only in these narrow gauge waggons, the system effects nothing as regards the passage in one direction. But even with regard to the passage from the narrow gauge to the broad gauge the system will not bear examination. If the trucks are supported on springs there is practically a difficulty in running the waggons upon them; and if they are not supported on springs, they will sustain great injury on the journies. If they are loaded singly there will be a great delay; if they are placed in a row, and the narrow gauge carriages are run through the whole series, very great caution will be necessary to secure each carriage both in front and in rear. When heavy loads are thus placed in elevated positions, and when the security of each depends upon adjustments hurriedly made, there will be the danger to which we have alluded in noticing the first proposed construction. Finally, an enormous amount of dead weight will be carried on the broad gauge line. We reject this proposal as entirely inapplicable to the traffic of railways.

The system of shifting the bodies of carriages from road wheels to railway wheels is practised successfully in France, where the diligences from Paris to distant towns, proceeding on road wheels from the Messagerie of Paris to the railway station, are carried on a peculiar railway truck as far as Rouen and Orleans, and are then again placed on road wheels to continue their journey. At the low speeds of the French railways this system is safe, but we doubt whether it would be safe with the speeds of the English railways. Moreover, it deprives the railway system of one of its greatest conveniences; namely, its readiness to receive almost any number of passengers without warning, and to carry them to any distance small or great. Carriers' carts are also conveyed (but to no great amount) in the same manner. In France, as we understand, it is not thought likely that the system will be in any degree retained when those railways shall have been extended further. The same remarks, we conceive, would apply entirely, or in a great measure, to similar proposals for the shifting of the bodies of railway carriages; but as this plan has never been strenuously urged, it is unnecessary to criticise it more minutely.

The system of conveying goods in loose boxes, carried upon railway trucks, has been seriously discussed. It has been repeatedly tried, and we are able therefore to give an opinion on it, founded on experience. The result of this experience is, that in one instance of a temporary character, where the whole operation was under the control of one engineer, it succeeded: in other instances, although always under the control of one engineer or one company, it has usually failed; aud these failures have occurred where, from the deterioration caused by hand-shifting, to the mineral conveyed, it was matter of anxiety to avoid transference of the load from one box or waggon to another, and where no expense was spared in the erection of machinery proper for the transference of the loose boxes. These failures, it is to be remarked, occurred in a traffic which is comparatively regular, viz., that of coal; in traffic of a less regular character the causes tending to produce failure would be very much more numerous. We consider that this method is totally inapplicable to remedy the inconvenience of a break of gauge. Some of the witnesses whom we have examined are of opinion that there would be less difficulty in unloading the waggons of one gauge, and placing the articles in waggons of the other gauge, by having two rows of waggons on the different gauges, marshalled alongside of each other; but having witnessed this process at Gloucester, we are of opinion that such a system is totally inapplicable to an extended traffic. We sum up our conclusions on this head, by stating our belief that no method has been proposed to us which is calculated to remedy, in any important degree, the inconveniences attending a break of gauge.

III. Considerations on the general policy of establishing an uniformity of gauge throughout the country. We approach this momentous question with a full conviction of its importance, and the responsibility that rests upon us. That an uniformity of gauge is now an object much to be desired, there can, we think, be no question. In the earlier period of the railway history of this country the great trunk lines were so far separated as to be independent of each other, and, as it were, isolated in their respective districts, and no diversity of gauge was then likely to interfere with the personal convenience, or the commercial objects of the community; but now that railways are spreading in all directions, and becoming interlaced with each other in numerous places, that isolation is removed, that independence has ceased, and the time has arrived when, if steps cannot be taken to remove the existing evil of the diversity of gauge, at least it appears to us imperative that a wider spread of this evil should be prevented.

If we had a wish to deal with a question not affecting the interests of parties, who are not only unconnected, but who are opposed to each other in a spirit of emulation, if not of rivalry; or if we were dealing with the property of the public, and not of private trading companies, we should merely have to consider whether that uniformity of gauge which we deem to be so desirable would be too dearly purchased by an alteration of one gauge to suit the other, or of both to some fresh gauge which might be considered preferable to either, if any such there be. But our position is different to this, since we have to consider not only the relative length of the different systems, the mechanical efficiency of each, the general superiority of one above the other, their adaptation to the wants of the country, and the possibility as well as the policy of a change, but also the pecuniary means of effecting it. We have further to look to the consequences of an interruption of the traffic during the progress of an alteration.

There is still another view of the question, and that is, the expediency of having, on lines of railway, additional rails, so as to afford the facility of using engines and carriages on both gauges. This expedient, in whatever form adopted, cannot be considered as free from difficulties. If two rails, forming a narrow gauge way, are placed between the two rails which form a broad gauge way, carriages of the different gauges may run in the same train, without alteration even of their buffers, which in the ordinary construction of the carriages correspond exactly on the broad and narrow gauges. But the expense of such an insertion would probably not be less than that of an entire change of gauge, including in the latter the change of engines and carrying stock; and the complication which it would introduce at the crossings might produce danger to rapid trains, unless their speed were diminished at approaching such points. The difficulty of packing the rails, if longitudinal sleepers were used, would also be much greater than if rails of only a single gauge were employed. If a single rail were inserted centrically in a broad gauge way, so as to form, in conjunction with one of the broad gauge rails, a narrow gauge way, the expense of the insertion, and the danger of the crossings, as well as the difficulty of packing the rails, would be somewhat diminished, but it would be imprudent to run carriages of the different gauges in the same train, and as it would probably be the policy of the railway company to adopt for their own stock of engines only one of the two gauges, and to interpose those difficulties which amount to a prohibition of the use of other companies' engines, the inconvenience of a break of gauge would exist in almost all their force at every junction of a branch railway on a different gauge. We consider, therefore, that the general adoption of such a system ought not to be permitted. We remark, however, that the difficulties to which we have alluded may be greatly diminished on any railway where the system of combined gauges is cordially taken up by the company; and we think that great respect ought to be paid to the rights which the companies may be supposed to possess in the methods or systems which they have devised or adopted. At the same time, we lay it down as the first principle, that intercommunication of railways throughout the country ought, if possible, to be secured. If, to obtain the last-mentioned object, it should be necessary to alter or make a change in any existing railways, we think that it may be left as a matter of ulterior consideration for the legislature, whether in these limited instances the combination of gauges may not be allowed.

Whatever may be the course which at the present time circumstances will permit, it will appear from the opinion we have expressed, that we think, abstractedly, equalization desirable; and we shall therefore proceed to consider what gauge would be the best in such a system of equalization.

We shall examine this part of the question under the following heads:—1. Safety. 2. Accommodation and convenience for passengers and goods. 3. Speed. 4. Economy. We will commence with the question of safety.

We are of opinion that experience will, in this matter, afford a better test by which to compare the systems of the broad and the narrow gauge than any theory; and we therefore have made inquiry into the nature of the accidents recorded in the official reports of the Board of Trade, as well as of such as have happened since the last report was published. We find that railway accidents arise from collisions, obstructions on the road, points wrongly placed, slips in cuttings, subsidence of embankments, a defective state of the permanent way, loss of gauge, broken or loose chairs, fractures of wheels or axles, &c.; and, lastly, from engines running off the line from some other cause.

Of these several classes of accidents, all except the last are obviously independent of the gauge; and with reference to this last class, we have thought it right to endeavour to determine whether the advocates of either gauge could fairly claim, in regard to these accidents, a preference for their respective systems, on the score of greater security to the traveller. In these lists we find only six accidents of the kind we are considering recorded from October, 1840, to May, 1845, whereas there have been no less than seven within the last seven months, and these are all attributable to excessive speed, the majority having happened to express trains. Of the whole number of these accidents, three have occurred on the broad gauge, and ten on the narrow; the former, however, differ in their character from the latter, the carriages only, in the last two cases, having been off the line, whereas, in all the 10 narrow gauge cases, the engines have run off, and the consequences have been more fatal. We must here observe, however, that the extent of the narrow gauge lines is 1,901 miles, and that of the broad only 274; therefore the comparison would be unfavourable to the broad gauge if considered merely with regard to their relative length; but it must be borne in mind that the general speed of the Great Western considerably exceeds that of many of the narrow gauge lines, and that some consideration is on that account due to the broad gauge.

The primary causes of engines getting off the rails appear to be over driving, a defective road, a bad joint, or a badly balanced engine. If, in consequence of heavy rains or other unfavourable circumstances, any part of the road becomes unsound, the engine sinks on one side as it passes along such part of the rail, suddenly rises again, and is thus thrown into a rocking and lateral oscillatory motion, with more or less of violence according to the rate of speed, and a very similar effect is produced in passing at high speeds from one curve to another of different curvature. A succession of strains is thus thrown upon the rails, and if, before the rocking subsides, the wheel meets with a defective rail or chair, which yields to the impulse, the engine and train are thrown off as a necessary consequence; but, as far as we can see, such casualities are equally likely to happen on either gauge, other circumstances being similar.

It has indeed been stated by some of the witnesses whom we have examined, that the broad gauge is more liable to such accidents, from the circumstance that the length of the engine, or rather the distance between the fore and hind axle, is less in proportion to its breadth than in the narrow gauge engines, and that therefore the broad gauge engines is liable to be thrown more obliquely across the lines, and in case of meeting with an open or defective joint, more liable to quit the rail; but we cannot admit the validity of this objection against the broad gauge lines. It may be that the proportion between the length and breadth of the engine has some influence on its motion, and that motion is somewhat less steady, where the difference between the length and breadth is considerably diminished; but practical facts scarcely lead to the conclusion that the safety of the trains is endangered by the present proportion of the broad gauge engines; for it appears that on the London and Birmingham Railway, where the engines hitherto employed have been, generally, short four-wheeled engines, the distance from axle to axle not exceeding 7 feet, or 7 feet 6 inches, no such accident as we are considering has been reported: and we are informed by the superintendent of that line, that no such accident has ever occurred. The same remark applies to some other narrow gauge lines; and if, as has been stated, exemption from these accidents has resulted from the close fixing of the engine and tender adopted on this line, the same system might be adopted on any other line, whether on the broad or narrow gauge. An evil may also sometimes arise in six-wheeled engines by the centre of gravity of the engine being brought too much over the driving wheels, and the springs being so adjusted, for the sake of the adhesion of the wheels to the rails, that the front wheels would have little or no weight to support, and would be thus in a condition, by any irregularity in the road or other obstruction, to be more easily lifted off the rails. But here again, if this fault in the construction or adjustment has been any where committed, it is a fault or defect wholly unconnected with the breadth of gauge.

Another cause of unsteady or irregular motion, dangerous to the safety of the train, has been stated to be the great overhanging weight beyond the axles of some engines of recent construction, and of the weight of the outside cylinder beyond the axles bearings. So far as this construction is concerned, it certainly appertains to narrow gauge lines only; but at the same time we must remark, that it is not essential to their working. Upon the whole, therefore, after the most careful consideration of this part of the subject, we feel bound to report, that as regards the safety of the passenger no preference is due, with well-proportioned engines, to either gauge, except perhaps at very high velocities, where we think a preference would be due to the broad gauge. On this part of the subject we would beg to point to the nature of the evidence of Mr. Nicholas Wood.

We have now to advert to the question of the relative accommodation and convenience for passengers and goods. The first class carriages of the broad gauge are intended to carry eight passengers in each compartment, and the compartments are sometimes subdivided by a partition and inside door. On the narrow gauge lines the first-class carriages are usually constructed to carry only six passengers in each compartment; and we find that about the same width is allowed for each passenger on both gauges. Some of the original mail carriages were adapted for four passengers, and we believe that the public had a preference for these carriages over both the other descriptions. Until lately, the broad gauge carriages were altogether more commodious than those of the narrow gauge, but recently carriages have been introduced on several of the narrow gauge lines nearly as lofty as those on the broad gauge, and equally commodious; in short, we now see no essential difference as regards accommodation and convenience to individual passengers in the first-class carriages of the two gauges. In the second-class carriages on the broad gauge, six persons sit side by side, each carriage being capable of holding 72 passengers. On the narrow gauge generally, only four persons sit side by side, the total number in each carriage being 32; in this respect we are inclined to consider the latter are more comfortably accommodated. With reference to the ease of the carriage, and the smoothness of the motion, we have had very contradictory evidence, and it must be admitted that great difference is experienced on the same line at different times, depending upon the state of the road, the springs of the carriage, the number of persons in a carriage to bring the springs into action, the position of the carriage in the train, and the speed at which the train is propelled, all of which conditions are independent of the breadth of the gauge. We have, however, with a view of making our observations on this question, travelled several times over all those lines having their stations in London, and after making, to the best of our judgment, every allowance for the circumstances above-mentioned, we are of opinion that at the higher velocities the motion is usually smoother on the broad gauge.

It is now to be considered whether either gauge has a superiority over the other in regard to the conveyance of general merchandize. Under this head we class manufactured goods and their raw materials, mineral products, such as coal, lime, iron, and other ores; agricultural produce, such as corn, hops, wool, cattle, and timber. On these points we have taken the evidence of persons well acquainted with the carrying trade, and from their information, and our own observation, it does not appear to be of consequence to the parties sending or receiving goods whether they are transmitted in waggons, containing four or six tons, or in waggons of larger capacity, provided that the cost and security are the same, and that the carriers undertake the responsibility of any damage that may result from the size of the load. But Messrs. Horne and Chaplin, and Mr. Hayward, who are largely interested, and have had great experience in the carrying trade, have expressed a strong opinion that the smaller waggon is far the more convenient and economical. The same opinion is still more strongly expressed by those witnesses we have examined who have experience of our mineral districts. These persons state that the smaller waggon can be more easily handled, and can be taken along sharper curves than would be suited to a broader waggon; that such sharp curves are very common in mineral works and districts, and that the broken nature of the ground would render curves of greater radius inconvenient and expensive.

Another important difference between the two gauges, in this commercial view of the question, would present itself in localities in which there may be a difficulty of readily obtaining full loads for the waggons at road stations. Here the defect of the dead weight, which we find to apply more particularly to the broad gauge, would be greatly increased, unless another evil of still greater commercial importance were created, that of detaining the waggons to receive full loads. On the whole, therefore, we consider the narrow gauge as the more convenient for the merchandize of the country.

We now come to the important consideration of relative speed. With a view to form our judgment on this subject, we have examined the time-table of the several companies having express and fast trains, and the returns furnished by those companies of the actual speeds attained by the express trains, on 30 successive days, from the 15th of June to the 15th of July, 1845. We have also, on various occasions, travelled in the express trains and noted the speed, mile by mile. The result has been, that we are fully satisfied that the average speed on the Great Western, both by the express trains and by the ordinary trains, exceeds the highest speed of similar trains on any of the narrow gauge lines. But some of the latter have trains which exceed in speed the corresponding trains of the Bristol and Gloucester line, and also of the Swindon and Gloucester line, both of which are on the broad gauge; but these latter, it is to be remembered, are still of recent construction, with unfavourable curves and gradients; and we have been informed by Mr. R. Stephenson, in his evidence, that at one period the speed on the Northern and Eastern line even exceeded that of the Great Western.

In treating of a difference in the speed, other circumstances besides the mere gauge must be considered. The inclinations and curves of the Great Western Railway, between London and Bristol, and even for 40 miles beyond Bristol, are, with the exception of the Wotton-Bassett and the Box inclines, particularly favourable to the attainment of high velocities; and it is important to remark, that the inclinations and curves on that part of the Northern and Eastern Railway where the competition in speed with the Great Western was the most successful, are generally of a similar character.

One of the principal motives professed for constructing the Great Western Railway on the broad gauge was the attaining of high speeds, and the credit of the proposers and defenders of that construction has therefore been deeply engaged in maintaining them. The effect of gradients on the speed of the Great Western trains, even with the powerful engines used on that line, is shown in the Time Table, where we find that while the speed from Paddington to Didcot by the express train is 47½ miles per hour, from Didcot to Swindon it is only 41·1, and from Swindon to Gloucester only 31·7; from Swindon to Bath it is 48·2, but returning only 37·2; from Bristol to Taunton, the speed is 46·3, and from Taunton to Exeter only 39·2. We must observe, however, that while the Great Western Company have not altered in any degree the plan of their engines, the higher velocities of the narrow gauge lines have been attained by the introduction of a more powerful kind of engine than was employed at an earlier period, and probably the new engines now used on the narrow gauge lines are as powerful as they can well be made within the limits of their gauge; whereas the broad gauge lines have still a means of obtaining an increase in the power of their engines, and of increasing their speed, provided the road be in a condition to sustain the great increased force which must result from any increased weight of the engine moving at such velocities. Whether the permanent way is in such a state at present is very questionable, or even whether it be possible in all vicissitudes of weather to maintain it in such a condition. We ought not to lose sight of the fact, that since the introduction of express trains, the accidents arising from engines running off the line have been much more common than in former years; indeed, these accidents have been more numerous within the last seven months than within the preceding five years, and it is questionable whether this contest for speed ought to be carried to any greater length. We are, indeed, strongly inclined to the opinion stated by several engineers in their evidence, that it is the stability of the road, and not the power of the engine, that will prescribe the limits of safe speed.

On the first introduction of passenger railways, speeds of about 12 miles per hour only were anticipated: the rails then employed weighed only 35lb. per yard, and the engines about six or seven tons. As soon as speeds of 20 and 24 miles per hour were attempted, it was found necessary to have rails of 50lb. per yard, and the engines weighing 10 or 12 tons. Since that time the rails have been increased in weight progressively to 65lb., 75lb., and 85lb. per yard, and the weight of the engine on the broad gauge exceeds 22 tons, and on the narrow gauge it now approaches 20; indeed, we have seen a narrow gauge engine on six wheels, weighing 30 tons. We doubt, however, whether a corresponding stability has been attained in the road itself.

Amongst other changes for increasing the power of the engine and the speed of the trains of the narrow gauge lines, there have been the giving an increased length to the engine, and the placing the cylinders on the outside of the framing; but it is the opinion of some of the witnesses we have examined, that this position of the cylinder has a tendency to produce a greater wear and tear of the journals, and a consequent rocking and irregular motion of the engine on the line. This, however, while the engine is of medium length, has been denied by Mr. Locke, who has had great experience in the working of outside-cylinder engines. But it is stated by Mr. Gray and Mr. Gooch, that where the length of the engine is greatly increased, this increased length, by causing the extremities of the engine to overhang very considerably the fore and hind axles, has a great tendency to increase the irregular motion produced by the outside-cylinder. Mr. R. Stephenson admits that in some of the latter engines this irregularity does exist, but he attributes it to the weight of the piston and its appendages, observing, "I do not believe that it is the steam that causes the irregular action, but I believe it to be the mere weight of the pistons themselves, and therefore if we could contrive to balance the piston by the weight upon the wheels, we should get rid of that very much." At all events, from whatever cause the motion may arise, the oscillations are very considerable in some of these long engines, and such as can scarcely be considered safe at high velocities. This great length of engine is, however, by no means essential to the attainment of high speeds on narrow gauge lines. We found, by timing the express trains on four different journeys on the South Western line, in both directions, that the whole distance was performed very satisfactorily in about 1 hour and 52 minutes, including the time of two stoppages, being at an average rate of 41 miles per hour, on a line which, in one direction, rises for a length of more than 40 miles on a very prevailing gradient of 1 in 330; and in the other rises for several miles on a gradient of 1 in 250. On each occasion a distance of five miles, on a level part of the road, was passed at the rate of 53 miles per hour. The length of the engine boiler was only eight feet, seven inches, the driving wheels six feet six inches in diameter; the leading wheels had both inside and outside bearings. The diameter of the cylinder in one case was 15 in. in the others 14¼ in. both outside, and attached to the smoke-box.

In proceeding to compare the locomotive engines, we remark, in the first place, that the fire-boxes, boilers, &c., of the narrow gauge engines still possess a smaller evaporating power than those of the broad gauge engines, although recent attempts have been made to raise the former to the level of the latter; but those attempts have not succeeded; and it is indisputable, that whatever can be done for the narrow gauge, in this respect, can be surpassed on the broad gauge. And we concur in opinion with many of the ablest engineers, who have stated, that the engines of both gauges have nearly obtained the speed and power which it would be justifiable to employ in reference to the present strength of the rails and the firmness of the earthworks. We remark, in the next place, that the diameter of the driving wheels of the broad gauge engines is greater than that of the driving wheels of the narrow gauge engines, and although in many of the narrow gauge engines the use of the external cylinder has enabled the manufacturers to bring the boilers nearer to the driving wheel axles, and has thus permitted an increase of the diameter of the wheel, still it is always in the power of the constructors of broad gauge engines to make a corresponding change, and thus to maintain the superiority; for the larger diameter of the wheel is unquestionably favourable to high speed, both because the steam is used to greater advantage, and because the alternating shocks upon the machinery are less rapid. It is, however, extremely difficult to say at what speeds this advantage becomes appreciable. We think it likely, that as far as the speed of 40 miles an hour, there is no great difference between the two, but that for speeds of 50 or 60 miles an hour, the difference may be worthy of notice. It becomes important, then, to inquire what may be the greatest speed that will probably be desired or maintained on railways for ordinary purposes.

It is certain that the wishes of the public will be limited only by considerations of economy and safety. The greater the speed, the greater will be the cost; and it appears to be the opinion of many of the officers of railways that it would be difficult to maintain with safety the present express speeds upon the great trunk railways. The chief impediments to maintaining the present express speeds are,—1. The difficulty of arranging the trains, where the traffic is frequent, so that the fast trains shall be entirely protected from the chance of interfering with or coming into collision with the slower trains, or those that stop at numerous stations. 2. The difficulty of seeing signals, especially in foggy weather, in time to enable the engine-driver to stop the fast trains. We feel it a duty to observe here, that the public are mainly indebted for the present rate of speed, and the increased accommodation of the railway carriages, to the genius of Mr. Brunel, and the liberality of the Great Western Railway Company. As regards the applicability of the atmospheric principle of traction, or of any other principle differing from the locomotive, we see no difference between the two gauges.

The question of economy is that which next demands our attention. Under this head we have to consider the cost of construction, the purchase of the plant, which consists of engines, of carriages, and of other carrying stock; and lastly, the cost of working. There can be no question that, in the first construction of a railway, the narrower the gauge, the smaller will be the cost of the works. This applies to tunnels, bridges, viadacts, embankments, cuttings, sheds, workshops, turn-tables, transverse sleepers, and ballast, and the purchase of land; but it does not affect the rails, fences, drains, and station-houses. The exact difference, however, must depend in a great degree upon local circumstances, and no opinion can be given of the precise ratio of difference without going into a very minute calculation of each line on which the two systems are to be compared; for instance, in a line free from tunnels or viaducts, and in a flat country, where there are neither cuttings nor embankments, the difference would be limited very nearly to the quantity of land to be purchased (the severance and damage being about equal in both cases), the amount of ballasting, and some increase in the cost of the sleepers; whereas, in a very undulating country, the difference would be more considerable. As to the cost of the maintenance of way, supposing the construction to be the same, that of the broad gauge must be rather the greater of the two. In respect to the cost of the engines and carrying stock, we have to observe that they are generally more expensive on the broad than on the narrow gauge. But, on the other hand, it is asserted by the advocates of the broad gauge system, that as the engine will draw greater loads, as the carriages will accommodate a greater number of passengers, and as the waggons are capable of conveying a larger amount of merchandize, the work can be and is done at a less charge per ton, and that a compensation is thus obtained for the increased outlay. How far this is found to be practically the case is the next subject for inquiry.

We were very desirous, if it had been found possible, thoroughly to investigate this part of the subject by means of the official data called for by us, and furnished by some of the principal companies, containing a statement of their working expenses; but we find the circumstances so different, that very little satisfactory information can be thus obtained, that has strictly a reference to the economy of the two gauges. There are, of course, various matters that have an influence on the actual cost of locomotive power and general traffic charges, that are in no way connected with the breadth of gauge; such as the nature of the curves and gradients, the price of coke, the general nature of the traffic, the mode of working that traffic as adopted by different companies, the employment of engines of greater or less power, that increased accommodation to the public which involves an extra expense for return carriages, &c. The London and Birmingham, and the Great Western Railway, as metropolitan lines of great traffic and of considerable length, would at first sight appear to furnish the best means of comparison, and there is, in fact, no difficulty in comparing the actual expenses; but these lines differ essentially in the character of their gradients, and in the amount of traffic, estimated at per mile, and above all, they differ in the character of the engines they employ.

The London and Birmingham Company have, from the commencement, persevered in the use of light four-wheeled engines, while the Great Western, availing themselves of the facilities their gauge affords, have adopted large and powerful engines, which are worked at nearly the same cost per mile as the former; and if such engines, as those on the London and Birmingham line, were essential to the narrow gauge, the question as to the economy of working might be at once decided in favour of the broad gauge; but this is by no means the case: several narrow gauge lines employ engines of great power, and work, in consequence, much more cheaply than the London and Birmingham; therefore, the comparison between the working expenses of this line, and of the Great Western, can only be considered as a test of the principle of working with light and with heavy engines, and not as furnishing a test of the working economy of the two gauges.

It is a common practice with different railway companies, in their half-yearly reports to their proprietors, to state the per centage of their various expenses, under a few distinct heads, as compared with their revenue; and from these it appears that on the Great Western, the locomotive charges, during a period of three years, have varied between 8·8 and 11·1, averaging 9·7 per cent. on their income; and on the London and Birmingham they have varied, within the same period, between 7·9 and 10·36, averaging about 8·6 per cent. on their income; and, therefore, on a superficial view of the question, the London and Birmingham would appear to have worked their line at a cheaper rate; but valid objections have been made to this comparison on the part of the Great Western; because it is obvious, from the several returns we have received, that the London and Birmingham Company has far the more abundant traffic per mile, and ought, therefore, to be expected to perform its work at a less per centage on its income. It has been stated by Mr. Gooch, that as locomotive superintendent to the Great Western, he is called upon to supply a certain amount of locomotive power, and that the cost of such power is almost entirely irrespective of the load or number of passengers it is made to draw; but that these numbers are of great importance in comparing the locomotive expenses with the revenue. In the appendix to this report, an abstract and comparative table are given, founded on returns furnished by the Great Western and London and Birmingham Railway Companies, showing that the revenue derived from the passengers' train is 64 per cent. greater per mile worked on the latter than on the former line. It must, therefore, be obvious that, as a test of economy for working, we cannot adopt the principle of a per centage on the revenue, neither will the cost per mile run give a more just comparison as to the economy of the two systems, because it is a well-known fact that the London and Birmingham Company have been conveying their traffic with engines of inadequate power, and that great economy would result to them by the adoption of larger engines. Other difficulties also occur in the comparison of these expenses on different lines, in consequence of the difference in the form of the accounts, and of the circumstance of one company adopting the principle of having a reserve fund for renewals, and other companies having no such fund. We are, therefore, of opinion that the most satisfactory comparison that can be made of the economy of working the two gauges will be by applying to first principles, endeavouring merely to determine what the working expenses of the Great Western line, with their present amount of traffic, would have been, provided it had been made a narrow gauge line, and worked with such engines as those employed on the South Western and some other narrow gauge lines.

The average weight of a passenger-train on the Great Western Railway (independent of the engine and tender, which weigh 33 tons) appears, by the returns sent to us, to be of 67 tons; and the average number of passengers per train for the half-year ending the 30th of June, 1845, as appears by our comparative table, is only 47·2, whose weight, including their luggage, may be estimated at about 5 tons. Mr. Gooch estimates each carriage and its passengers on the broad gauge to weigh about 9½ tons, and therefore there would be seven carriages to make up the 67 tons above specified. The most commodious carriages on the narrow gauge lines, such as those on the South Western, weigh less than 5 tons; seven such carriages would therefore weigh about 34 tons, and being capable of containing 126 first-class passengers, weighing with their luggage, 12½ tons, the total load would be only 46½ tons. Now we find, that even with a traffic as large as that of the London and Birmingham Railway, the average per train would only be 84·9 passengers, weighing about 8 tons; so that, under the supposition of a traffic of this extent, the load of the seven narrow gauge carriages so occupied would only be 42 tons. But Mr. Gooch estimates, from his own experiments, the relative powers of traction of the broad gauge engines, and of the narrow gauge engines of the South Western Railway, when working at the same speed, as 2,067 to 1,398, or as 67 per cent., the load of the broad gauge in tons, to 45 tons, which would be the corresponding load for the narrow gauge, so that the narrow gauge engine has more power over the 42 tons it would have to draw than the broad gauge has over its average load of 67 tons, both exclusive of the weight of the engine and tender, the narrow gauge carriage in this supposition being supposed to contain 84·9 passengers, and the broad gauge only 47·2 If, however, it were necessary, 224 first-class passengers might be placed in the seven broad gauge carriages, and, as it has before been said, 126 in the seven narrow gauge carriages; but it appears likely that this extent of accommodation would only be called for on such rare occasions, that the question of providing for it, except by assistant power, cannot be taken into consideration in the present comparison.

It is obvious, from the foregoing statement, that the narrow gauge engine of the class we have been considering has more power over the seven narrow gauge carriages, and a load of 126 passengers, than the broad gauge engine has over the seven broad gauge carriages, and the load of the same number of passengers; and that, therefore, if the Great Western had been a narrow instead of a broad gauge line, the South Western engines would have had the same command over the existing passenger traffic of the Great Western as its own engines now have with the present construction of that railway. We must remark, however, that this calculation is for trains consisting exclusively of passengers and their personal luggage. In the Great Western average trains of 67 tons, there is an allowance of about 16 tons for passengers and luggage, including gentlemen's carriages. Allowing the same weight of luggage on the narrow gauge line, the train would not exceed 50 tons, which is considerably within the power of the narrow gauge engine. For it appears, by the experiments that have been recently made on the Great Western Railway, the details of which are given in the appendix to the evidence, that the Great Western engine is capable of propelling 13 tons at a greater speed than the average speed of that line; and consequently, by the proportion above stated, the narrow gauge engine would be capable of propelling 55 tons at the same rate. We conclude, therefore, that the work would be performed at about the same expense for locomotive power. That there may be cases in which not only the full power of a broad gauge engine is required, but even the assistance of a second engine is quite certain, but such trains form the exception and not the rule in railway passenger traffic, and we doubt the soundness of a principle which involves a great expense in construction, for the sake of possessing capabilities so seldom called into action.* It is proper to observe, that the foregoing comparison would have appeared to stand more in favour of the narrow gauge, had we taken for the engine of comparison, one of those engines, of whose increased capabilities some of the supporters of the narrow gauge system have informed us; but we have preferred the comparison afforded with the South Western engine, from its being the one on which Mr. Gooch, of the Great Western Railway, superintended the recorded experiments—hence our deductions are made from data furnished by the advocates of the broad gauge system, without drawing anything from the evidence on the other side; and as those deductions sufficiently demonstrate that there is no economy in the locomotive expenses for passenger-trains resulting from working a line on the broad gauge system, even on such lines as those which have at the present moment the most abundant passenger traffic, any anaylzation of the evidence offered in support of the narrow gauge system appears to us to be quite superfluous.

There is one point, however, stated in Mr. Gooch's comparative table, and repeated in his evidence, which appears so much at variance with the results we have obtained from other data as to require explanation. Mr. Gooch has asserted that the Great Western Company work their passenger-trains at half the expense per ton at which the London and Birmingham Company work their passenger-trains. The fact is, however, that Mr. Gooch's calculations refer to the gross and not to the net loads; and, therefore, the comparison is not applicable, so far as regards the profits of these companies, and affords no proof of economy in working the passenger traffic on the Great Western system. There can be no doubt, judging both from Mr. Brunel's evidence given to us, and from his report to the directors of the Great Western Railway Company, that he originally expected there would be on the Great Western Railway a demand for carrying great numbers of passengers at high velocities, but from his own evidence, it appears that the only heavy passenger traffic upon that railway is between London and Reading, and between Bath and Bristol, being a total distance of about 50 miles, out of 245. On the remaining part of the line the passenger traffic per train is small. If the convenience of the public would admit of the whole of the passenger traffic of this portion of the line being conveyed daily by two or three large trains, Mr. Brunel's views would have been perfectly correct in providing such powerful means; but experience has proved that the public require passenger-trains to be run many times during the day, and with this frequency of trains, such numbers of passengers as Mr. Brunel has provided for, cannot be expected even on railways of the largest traffic, so that practically there is a waste both of power and means. In the case of "goods' traffic" the circumstances are not the same. Railway conveyance for merchandise seems only to be required a few times in each day, and the trains are generally large. The "through" waggons have for the most part a full load, and the disproportion between the gross and the net weight is consequently much less than in the passenger-trains; still, however, it appears from the evidence of Mr. Horne, and of other persons connected with the carrying trade, that on the London and Birmingham Railway it frequently happens that waggons are forwarded to a considerable distance to "road-side stations," containing not more than a ton of goods, and there can be no doubt that this must happen on any long line of railway. The same also occurs in waggons coming in from branches along the trunk line, and in all such cases the heavy large waggon of the broad gauge must be disadvantageous; but although the evil is not so great with goods' waggons of the broad gauge as with their passenger carriages, still the loss by dead weight is greater with these than with smaller waggons, and we do not perceive any advantages in the broad gauge to counterbalance it; for where speed is not an object, and this is the case with goods' trains, we believe from the evidence we have received, that engines of nearly the same tractive power are to be found on many narrow gauge lines as those in use on the broad gauge.

Thus far we have considered the question with reference to the railways as they now exist, and composed in a great measure of trunk lines of considerable traffic, but the railways to be made in future will in some degree be branches or lines in districts having traffic of less magnitude than is to be provided for in the existing railways; and hence, if for the greater trunk lines a superiority were due to the broad gauge system, that superiority would be less for lines yet to be constructed of a smaller amount of traffic; and necessarily, if the preference were given to the narrow gauge for the existing lines, that system would be still more entitled to the preference for the railways of smaller traffic to which we look forward. We must here add that towards the close of our inquiry, Mr. Brunel requested, on the part of the broad gauge companies, to institute a set of experiments to test the power of their engines, and Mr. Bidder, on the part of the narrow gauge companies, undertook, in consequence of such application, to make corresponding experiments on the narrow gauge. After sanctioning these trials, and being present at the performance of them, a record of which will be found in the appendix, we may observe, without entering into a minute detail of the results, or the discrepancies between the returns as furnished by the two parties themselves, that we consider them as confirming the statements and results given by Mr. Gooch in his evidence, proving as they do, that the broad gauge engines possess greater capabilities for speed with equal loads, and, generally speaking, of propelling greater loads with equal speed: and moreover, that the working with such engines is economical where very high speeds are required, or where the loads to be conveyed are such as to require the full power of the engine. They confirm, also, the evidence given by Mr. Bidder as to the possibility of obtaining high evaporative power with long engines for the narrow gauge; but under somewhat peculiar circumstances. It appears, moreover, that the evaporation thus obtained does not produce a corresponding useful effect in the tractive power of the engine; a circumstance that would probably be differently explained by Mr. Gooch and by Mr. Bidder; but as we do not refer to the power of this description of engine in the deductions we have made, it is unnecessary for us to allude further to them.

After a full consideration of all the circumstances that have come before us, and of the deductions we have made from the evidence, we are led to conclude—

1. That as regards the safety, accommodation, and convenience of the passengers, no decided preference is due to either gauge, but that on the broad gauge the motion is generally more easy at high velocities.

2. That in respect of speed, we consider the advantages are with the broad gauge, but we think the public safety would be endangered in employing the greater capabilities of the broad gauge much beyond their present use, except on roads more consolidated and more substantially and perfectly formed, than those of the existing lines.

3. That in the commercial case of the transport of goods, we believe the narrow gauge to possess the greater convenience, and to be the more suited to the general traffic of the country.

4. That the broad gauge involves the greater outlay, and that we have not been able to discover either in the maintenance of way, in the cost of

* It appears that during the half-year ending June 30, 1845, the number of miles run by coupled and assisting engines for passenger-trains on tho Great Western Railway, amounted to 11,628, and for goods trains to 51,155. The total number of miles run by the former trains being 761,483, and of the latter, 150,324.

locomotive power, or in the other annual expenses, any adequate reduction to compensate for the additional first cost.

Therefore, esteeming the importance of the highest speed on express trains for the accommodation of a comparatively small number of persons, however desirable that may be to them, as of far less moment than affording increased convenience to the general commercial traffic of the country, we are inclined to consider the narrow gauge as that which should be preferred for general convenience; and, therefore, if it were imperative to produce uniformity, we should recommend that uniformity to be produced by an alteration of the broad to the narrow gauge, more especially when we take into consideration that the extent of the former at present in work is only 274 miles, while that of the latter is not less than 1,901 miles, and that the alteration of the former to the latter, even if of equal length, would be the less costly as well as the less difficult operation. We are desirous, however, of guarding ourselves from being supposed to express an opinion that the dimension of four feet eight and a half inches is in all respects the most suited for the general objects of the country. Some of the engineers who have been examined by us have given it as their opinion, that five feet would be the best dimension for a railway gauge; others have suggested 5 ft. 3 in., 5 ft. 6 in., and even 6 ft., but none have recommended so great a breadth as 7 ft., except those who are more particularly interested in the broad gauge lines. Again, some engineers of eminence contend that a gauge of 4 ft. 8½ in. gives ample space for the machinery of the engine and all the railway requirements, and would recommend no change to be made in the gauge. We may observe, in reference to this part of the question, that the Easteru Counties Railway was originally constructed on a gauge of 5 feet, and has since been converted into a gauge of 4 feet, 8½ inches, to avoid a break of gauge; and we have been informed that some lines in Scotland, originally on the gauge of 5 ft. 3 in., are about to be altered to 4 ft. 8½ in. for the same reason. Whatever might be the preferable course were the questions now to be discussed of the gauge for an entire system of railways, where none previously existed to clash with the decision, yet, under the present state of things, we see no sufficient reason to suggest or recommend the adoption of any gauge intermediate between the narrow gauge of 4 ft. 8½ in., and the broad gauge of 7 ft., and we are peculiarly struck by the circumstance, that almost all the continental railways have been formed upon the 4 ft. 8½ in. gauge, the greater number having been undertaken, after a long experience of both the broad and the narrow gauge in this country; nor must the fact be lost sight of, that some of these railways have been constructed as well as planned by English engineers, and amongst that number we find Mr. Brunel, the original projector of the broad gauge. Mr. Brunel was also the engineer of the Merthyr Tydvil and Cardiff Line, which is on the 4 ft. 8½ in. gauge; and we think that the motives which led to the adoption of the narrow gauge in that instance would equally apply to many English lines. We are sensible of the importance, in ordinary circumstances, of leaving commercial enterprise as well as the genius of scientific men unfettered; we therefore feel that the restriction of the gauge is a measure that should not be lightly entertained; and we are willing to admit, were it not for the great evil that must inevitably be experienced when lines of unequal gauges come into contact, that varying gradients, curves, and traffic might justify some difference in the breadth of gauge. This appears to be the view which Mr. Brunel originally took of the subject; for the Great Western proper is a line of unusually good gradients, on which a larger passenger traffic was anticipated, and as it touched but slightly on any mineral district, it embraced all the conveniences and advantages of the broad gauge system, and was comparatively free from the influence of those defects on which we have commented; but such a breadth of gauge, however suitable and applicable it may have originally been considered to its particular district, appears wholly inapplicable, or at least very ill suited to the requirements of many of our Northern and Midland lines. In reference to the branches already in connexion with the Great Western Railway, we may observe, that the greatest average train on the Oxford branch, for two weeks in July and October, was only 48 tons; on the Cheltenham branch, it did not exceed 46; between Bristol and Exeter, 53; and between Swindon and Bristol, it was under 60 tons. With such a limited traffic, the power of the broad gauge engine seems beyond the requirements of these districts.

We find, from an estimate furnished to us, and the general grounds of which we see no reason to dispute, that the expense of altering the existing broad gauge to narrow gauge lines, including the alteration or substitution of locomotives, and carrying stock, would not much exceed 1,000,000*l.*; yet we neither feel that we can recommend the Legislature to sanction such an expense from the public monies, nor do we think that the companies to which the broad gauge railways belong can be called upon to incur such an expense themselves (having made all their works with the authority of Parliament,) nor even the more limited expense of laying down intermediate rails for narrow gauge traffic. Still less can we propose, for any advantage that has been suggested, the alteration of the whole of the railways of Great Britain, with their carrying stock and engines, to some intermediate gauge. The outlay in this case would be very much more considerable than the sum above mentioned; and the evil, inconvenience, and danger to the traveller, and the interruption to the whole traffic of the country for a considerable period, and almost at one and the same time, would be such that this change cannot be seriously entertained.

Guided by the foregoing considerations, we most dutifully submit to your Majesty the following recommendations:—

1. That the gauge of 4 ft. 8½ in. be declared by the Legislature to be the gauge to be used in all public railways now under construction, or hereafter to be constructed in Great Britain.

2. That unless by the consent of the Legislature, it should not be permitted to the directors of any railway company to alter the gauge of such railway.

3. That in order to complete the general chain of narrow gauge communication from the north of England to the southern coast, any suitable measure should be promoted to form a narrow gauge link from Oxford to Reading, and thence to Basingstoke, or by any shorter route connecting the proposed Rugby and Oxford line with the South Western Railway.

4. That as any junction to be formed with a broad gauge line would involve a break of gauge, provided our first recommendation be adopted, great commercial convenience would be obtained by reducing the gauge of the present broad gauge lines to the narrow gauge of 4 ft. 8½ in. and we, therefore, think it desirable that some equitable means should be found of producing such entire uniformity of gauge, or of adopting such other course as would admit of the narrow gauge carriages passing, without interruption or danger, along the broad gauge lines.

J. M. Frederic Smith, Lieut.-Col., Royal Engineers.
G. B. Airy, Astronomer Royal.
Peter Barlow.

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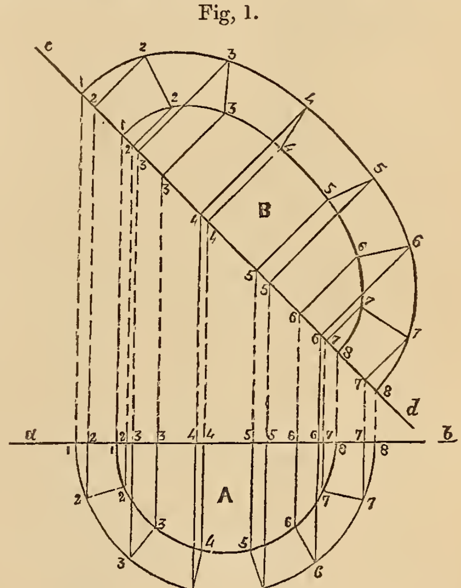
## Art. II.—PRINCIPLES OF HANDRAILING.

Before attempting to execute a hand-rail, the learner must perfectly understand the following diagram.

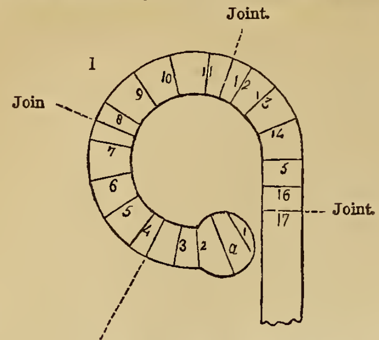
Fig, 1.



Divide the outer semicircle at A into any equal number of parts, as 1, 2, 3, 4, &c., radiating to the inner semicircle; draw lines from these perpendicular to the base line, *a*, *b*, cutting the raking line, *c*, *d*, in the points 1, 2, 3, 4, &c.; then B being pricked from A, as the figures direct, the semi-ellipsis B is the true section of the semicircle A. This contains the entire principle of handrailing: supposing A to be the plan of a rail, and *c*, *d*, the pitch, the semi-ellipsis B would be the face-mould.

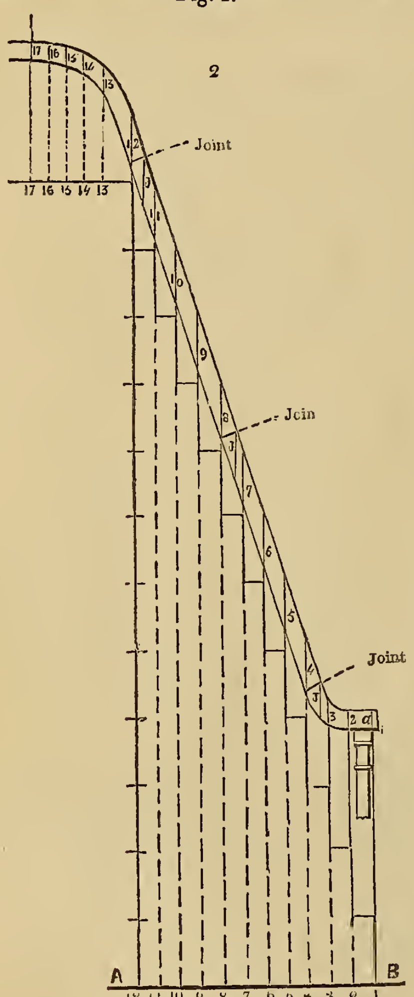
If a wreathed piece of rail is laid upon a level surface it will rest on several places, more or less, and the distance from these resting places to the highest part of the rail is the exact thickness of the plank required.

*To obtain the Falling Mould.*—Make a pattern of thin deal to the plan of the rail, and mark and figure the risers upon it, as *fig.* 1.; apply the round edge of this upon a straight line, and, turning it along, mark each ordinate from it, as 1, 2, 3, 4, &c., A B, *fig.* 2.; allow about 3 inches past the springing to join the straight rail on the landing, and divide it in the same manner, which gives the exact development of the handrail (the workman in setting out this, supposing himself to be on that side of the rail next the wall, otherwise the perpendicular lines will be on the wrong side of the falling mould). From the points 1, 2, 3, 4, &c. make 1 *a* equal to the height of a step, and 12 *b* equal to 12 steps; join *a* *b*, and the intersection of the raking line with the perpendiculars gives the height of the various steps; at any equal distance from this draw two parallel lines to represent the thickness of the handrail, as *c*, *c*, which, as the stairs are steep, will be 3 feet high to the upper side measuring plumb over the face of the riser; make the rail on the landing 5 inches higher, and curve the angle as shown by intersecting lines; keep the newel sufficiently high to allow the level mitre-cap to be



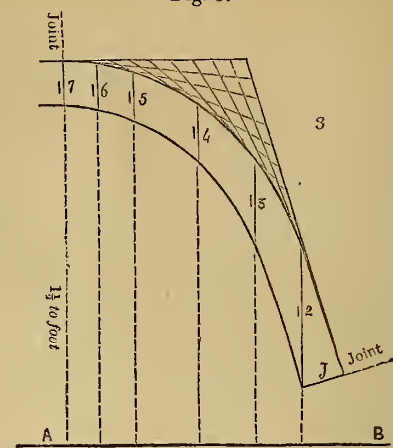

eased neatly into the raking-rail; mark and figure the situation of each riser, also the joints; and this completes the falling mould. No length of wreath-rail should exceed a quarter of a circle, as beyond this it runs into a curve of contrary flexure, thereby requiring extra thickness of stuff.

Fig. 2.



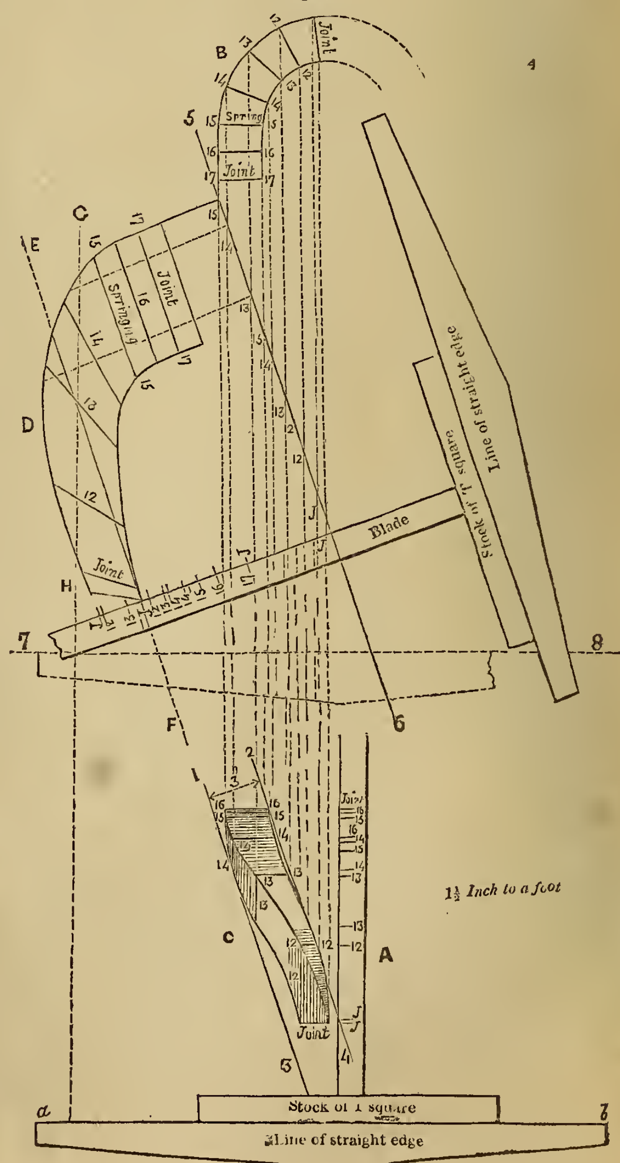

*To find the Pitch, and Thickness of Stuff required for the Rail, thence to trace the Face Mould.*—Mark and figure the various heights of the upper and under edges of the falling mould upon the blade of a deal T square, which is made to move tightly through a mortice in the stock, and applied at a straight edge, as A, B, *fig.* 3., which represents the upper part of the falling mould upon a larger scale, the square, with the heights marked on it, is shown at A, *fig.* 4. Fasten the pattern, *fig.* 1., with a broad-headed nail, at B, *fig.* 4; apply the T square to a straight edge, as *a*, *b*, and prick off each height of the falling mould, as marked on the blade, perpendicular under the corresponding points on the outer and inner edges of plan at B, as 16, 16, 15, 15, and at C, where the twist of the rail is shown by tracing a line through the various points. The dotted lines from B to C are drawn the proper position, but it must be turned round on the nail as a centre till the heights are contained in the least distance between two parallel lines,

Fig. 3.



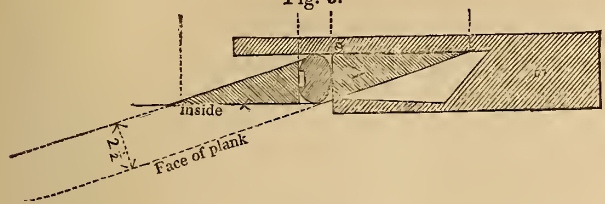

to define this more clearly: but in practice a slight pencil mark at each height is sufficient. There is no correct rule to fix the pattern B at once in

Fig. 4.



which represent the thickness of the plank required to square up the rail, as 1, 2, 3, 4, at C; but as the corners are worked off in moulding, it may be cut out of thinner stuff still, as *fig.* 5, where A is a view of the upper end of the rail-piece, a section through A, B, *fig.* 6, showing the position

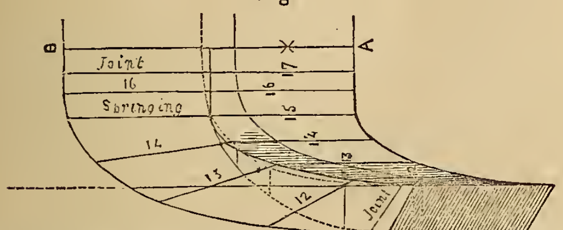
Fig. 5.




of the rail as finished, and the superfluous wood required to be cut away in squaring it up. By this method the rail may be cut out of any given thickness of stuff, by moving the pattern till the distance between two parallel lines is equal to the required thickness: the length of the face-mould depends upon the pitch, which is regulated by the thickness of the plank.

Draw a line, 5, 6, *fig.* 4.; parallel to 1, 2, 3, 4, at C.; apply the T square to a straight edge at the dotted line 7, 8; set 15, 14, 13, &c., on the line 5, 6, perpendicularly under the corresponding ordinates, at B, at the same

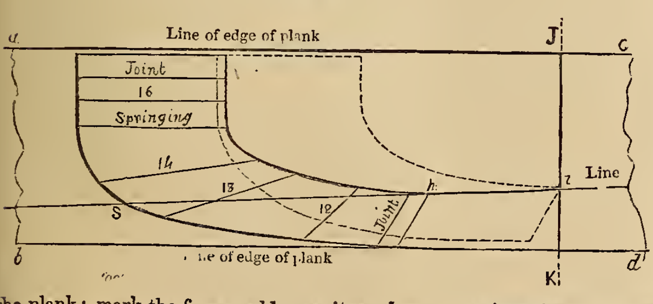
Fig. 6.




time marking the various heights of the outer and inner circumference upon the blade of the square; transfer these heights as the figures direct to 5, 6, and a curve being traced through them, produces the face-mould as D; radiate the ordinate across this, as shown, and draw the pitch-line E, F, at any equal distance from 5, 6, and intersect it by another line, as G, H, perpendicular to 7, 8, then the angle formed upon the face-mould by the junction of these lines is the pitch of the rail. It will be seen by this that the face-mould is pricked off the pattern B, in the same manner as the semi-ellipsis in *fig.* 0., but by transferring the heights upon the T square, instead of drawing lines upon the board, which is more confused and troublesome, the face-mould must be made about $\frac{3}{4}$ inch longer to allow for the joint.

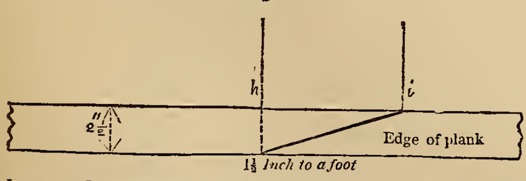
*To apply the Face-Mould to the Plank.*—Let *a, b, c, d, fig.* 7., represent

Fig. 7.




the plank; mark the face-mould upon it, as shown; continue the pitch-line *g, h,* along the plank, and make *h, i,* equal to *h, i, fig,* 8.; draw J K per-

Fig. 8.

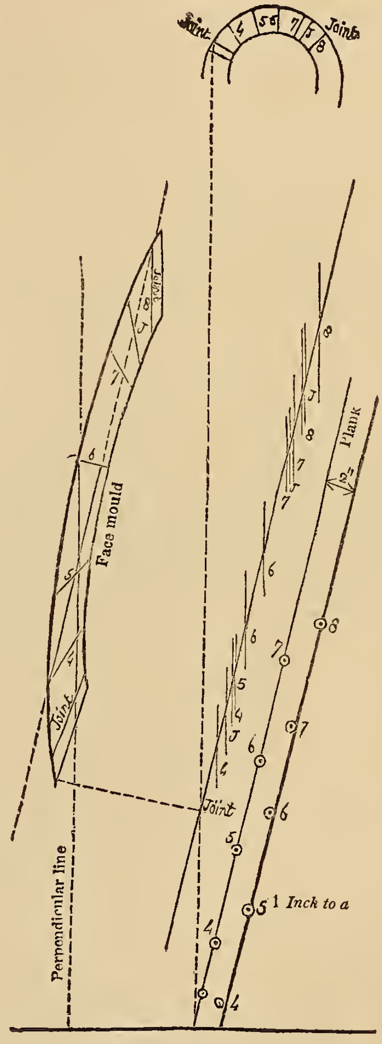



pendicular to *g, h,* intersecting it in the point *i*; produce *j, k,* and *g, h,* on the other side of the plank by pushing the notch-stick, *fig.* 9., upon the plank at the line *j, k,* till the mark *a* on the longest leg is at the point *i*; then the other leg being immediately under this shows the proper position

Fig. 9.

of *i* on the other side of the plank; from this draw a line coinciding every way with a plane passing through the pitch line *g, h,* at right angles to the face of the plank; keep the extremity of the face-mould at *h* fair with the point *i* on the plank; making the pitch-line on the former range with that on the plank, as shown by the dotted lines, cut the rail-piece out as marked, making the teeth of the saw range with the ordinates figured on each side of the plank, as 16, 15, 14, &c.

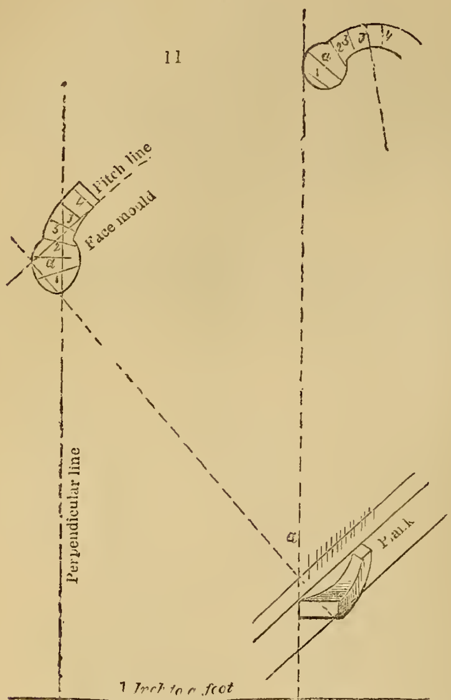
Fig, 10.




*To square up the Rail.*—Draw perpendicular lines upon the rail-piece from the various ordinates, as shown at *fig.* 6., which represents the rail-piece previous to being squared up, and applying the falling mould, the lines drawn upon which will agree with those on the former; slip the notch-stick upon the rail-piece at each line, keeping the mark *a* at the upper edge of the falling mould, and mark the position of the short leg upon the corresponding ordinate of the inner circumference of the rail, which is squared by sawing the superfluous wood away to these marks, making the teeth of the saw radiate to the various lines as figured, having worked the upper side of the rail to this gauge and to the proper thickness, and saw it as before; the dotted lines show the position of the rail when squared up.

This system of hand-railing has no reference whatever to the edge of the plank either bevelled or otherwise. The ends of the face-mould are left rough, and about three-fourths of an inch long, to allow for cutting the joint: the proper pitch of the rail in the plank is produced upon the pitch line; and when it is cut out, as *fig.* 6., and placed in proper position, the ordinates on the outer and inner circumference will be perpendicular over the corresponding points in the plan of the rail. The method of squaring the rail as described is infallible, as the perpendicular lines to which the notch-stick is applied radiate towards the centre, from which the plan is described.

Fig. 11.




In fig. 4. A. T. square with heights of falling mould marked on it B. Part of plan or pattern of the handrail. C. Thickness of stuff required to square up the rail. D. The face-mould. Fig. 8. Shows two parallel lines representing the thickness of the plank, to ascertain how much the rail rises in that thickness, as H, I. Fig. 9. A notchstick of thin deal used to square up the wreathed rail. Fig. 10. Shows thickness of stuff, face-mould, &c. for the two middle lengths of wreathed rail produced, as fig. 4. By tracing this face-mould from a two and half inch plank instead of two inch, as shown, less waste of material would be caused, as it might then be cut out of fig. 7. Fig. 11. Shows thickness of stuff, face-mould, &c., for mitre-cap and lower part of rail produced, as fig. 4.

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## Art. VI.—A CATECHISM OF THE STEAM-ENGINE.

42. What is meant by latent heat?—By latent heat is meant the heat existing in bodies which is not discoverable by the touch or by the thermometer, but which manifests its existence by producing a change of state. Heat is absorbed in the liquefaction of ice or in the vaporization of water, yet the temperature does not rise during either process, and the heat absorbed is therefore said to become latent. The term is somewhat objectionable as the effect proper to the absorption of heat has in each case been made visible, and it would be as reasonable to call hot water latent steam. Latent heat in the present acceptation of the term means sensible liquefaction or vaporization; but to produce these changes heat is as necessary as to produce an expansion of the mercury in a thermometer tube, and it is hard to see on what ground heat can be said to be latent when its presence is made manifest by a change of state. It is the temperature only that is latent, and latent temperature means sensible something else.

43. But when you talk of the latent heat of steam what do you mean to express?—I mean to express the heat consumed in accomplishing the vaporization compared with that necessary for producing the temperature. The latent heat of steam is usually reckoned at about 1000 degrees, by which it is meant that there is as much heat in any given weight of steam as would raise its constituent water 1000 degrees, if the expansion of the water could be prevented, or as would raise 1000 times that quantity of water one degree. The boiling point is 180 degrees above the freezing point, so that it requires 1180 times as much heat to raise a pound of water from the freezing point into steam as to raise a pound of water one degree, or it requires about as much heat to raise a pound of boiling water into steam as would raise $5\frac{1}{2}$ pounds of water from the freezing to the boiling point—$5\frac{1}{2}$ multiplied by 180 being 990 or 1000 nearly.

44. What do you understand by specific heat?—By specific heat I understand the relative quantities of heat in bodies at the same temperature just as by specific gravity I understand the relative quantities of matter in bodies of the same bulk. Quicksilver and water at the same temperature do not contain the same quantities of heat any more than equal bulks of those liquids contain the same quantity of matter. The absolute quantity of heat in any body is not known, but the relative heat of bodies at the same temperature, or in other words their specific heats, have been ascertained and arranged in tables—the specific heat of water being taken as unity.

45. What expansion does water undergo into its conversion in to steam?—A cubic inch of water makes about a cubic foot of steam of the atmospheric pressure.

46. And now much at a higher pressure?—That depends upon what the pressure is. The higher the pressure the smaller will be the volume of steam from a given quantity of water; for high pressure steam is just low pressure steam forced into a less space.

47. If this be so, the quantity of heat in a given weight of steam is the same whether it is high or low pressure steam?—Yes; the heat in steam is a constant quantity, or nearly so, at all pressures, if the steam be saturated with water. Steam, to which an additional quantity of heat has been imparted after leaving the boiler, or as it is called "surcharged steam," comes under a different law, for the elasticity of such steam may be increased without any addition being made to its weight; but surcharged steam is not employed for working engines, and it may therefore be considered in practice that a pound of steam contains the same quantity of heat at all pressures.

48. But the temperature of steam varies with the pressure?—Yes; the temperature rises with the pressure, but the latent heat becomes less in the same proportion. The latent heat of high pressure steam is less therefore than that of low pressure steam, while the sensible heat is greater, and the two taken together make up the same sum at all pressures.

49. Is there any limit to the force of steam?—Yes; there is a limit regulated by the modulus of elasticity of water, which at a temperature of 60 degress is 22,100 atmospheres. The modulus of elasticity of any substance is the measure of its elastic force, and if water be enclosed in a close vessel which it exactly fills, and be then subjected to heat, the expanding force, it is clear, is that of compressed water, for no steam can be produced under such circumstances, and we have this proportion, as the volume of expanded water is to the amount of expansion, so is the modulus of elasticity of water to the elastic force of steam of the same density of water.

50. Have experiments been made to determine the elasticity of steam at different temperatures?—Yes; very careful experiments. The following rule expresses the results obtained by Mr. Southern. To the given temperature in degrees of Fahrenheit add 51. 3 degrees, from the logarithm of the sum subtract the logarithm of 135.767, which is 2.1327940; multiply the remainder by 5.13, and to the natural number answering to the sum add the constant fraction .1, which will give the elastic forces in inches of mercury. If the elastic force be known, and it is wanted to determine the corresponding temperature, the rule must be modified thus:—From the elastic force in inches of mercury subtract the decimal . 1, divide the logarithm of the remainder by 5.13, and to the quotent add the logarithm 2.1327940; find the natural number answering to the sum, and subtract therefrom the constant 51.3; the remainder will be the temperature sought. The French Academy and the Franklin Institute have repeated Mr. Southern's experiments on a larger scale: the results obtained by them are not widely different, but they are more nearly expressed by the following rule: for temperature above 212 degrees. To the temperature in degrees of Fahrenheit add 121 degrees; from the logarithm of the sum subtract the logarithm 2.522444, and multiply the remainder by 6.42; the product will be the logarithm of the elastic force in atmospheres of 30 inches of mercury, or 14.76 lbs. on the square inch.

51. What law is followed by surcharged steam on the application of heat?—The same as that followed by air in which the increments in volume are very nearly in the same proportion as the increments in temperature. A volume of air which at the temperature of 32 degrees occupies 100 cubic feet, will at 212 degrees fill a space of $137\frac{1}{2}$ cubic feet. The volume of air or steam out of contact with water of a given temperature acquires, by being heated to a higher temperature, the pressure remaining the same, may be found by the following rule: to each of the temperatures before and after expansion add the constant number, 459; divide the greater sum by the less, and multiply the quotient by the volume at the lower temperature, the product will give the expanded volume.

52. If the relative volumes of steam and water are known, is it possible to tell the quantity of water which should be supplied to a boiler when the quantity of steam expanded is specified?—Yes; at the atmospheric pressure a cubic inch of water has to be supplied to the boiler for every cubic foot of steam extracted: at other pressures the relative bulks of water and steam may be supplied as follows:—To the temperature of the steam in degrees of Fahrenheit add the constant number 459. Multiply the sum by 75.7 and divide the product by the elastic force of the steam in inches of mercury, and the quotient will give the volume required. In practice, however, it is necessary that the feed-pump should be able to supply the boiler with a much larger quantity of water than what is indicated by these proportions, from the risk of leaks, priming, or the accidental subsidence of the water to a dangerously low level which it is necessary as speedily as possible to counteract. It appears expedient that the pump should be capable of raising three and a half times the water evaporated by the boiler: it is

therefore made about a 240th of the capacity of the cylinder for low pressure engines, supposing the cylinder to be double acting and the pump single acting. In high pressure engines, however, the capacity of the pump should be greater, in proportion to the pressure of the steam.

53. How do you estimate the quantity of water requisite for condensation?—Mr. Watt found that the most beneficial temperature of the hot-well of his engines was 100 degrees. If, therefore, the temperature of the steam be 212 degrees, and the latent heat 1000 degrees, then 1212 degrees may be taken to represent the heat contained in the steam, or 1112 degrees, if we deduct the temperature of the hot-well. If the temperature of the injection water be 50 deg. then 50 deg. of cold are available for the abstraction of heat, and as the total quantity of heat to be abstracted is that requisite to raise the quantity of water in the steam 1112 deg. or 1112 times that quantity, one deg. it would raise one-fiftieth of this, or 22.24 times the quantity of water in the steam 50 deg. A cubic inch of water, therefore, raised into steam will require 22.24 cubic inches of water at 50 deg. for its condensation, and will form therewith 23.24 cubic inches of hot water at 100 degrees. Mr. Watt's practice was to allow about a wine point (28.9 cubic inches) of injection water for every cubic inch of water evaporated from the boiler. The usual capacity for the cold water pump is 1-48th of the capacity of the cylinder which allows some water to run to waste.

54. How much water will a pound of coal raise into steam?—About 9lbs. of water in the majority of good land boilers, but in some of the Cornish boilers a pound of coal raises 12 pounds of water into steam or a cwt. of coal evaporates about 20 cubic feet of water. The weight of fuel burned on each square foot of grate-bars varies very much in different boilers: in waggon boilers it is about 12 or 13lbs., in Cornish boilers from $3\frac{1}{2}$ to 4 lbs., and in locomotive boilers about 80lbs. The number of square feet of heating surface for each square foot of fire grate is in waggon boilers from 14 to 15 square feet; in Cornish boilers about 40 square feet, and in locomotive boilers upwards of 70 square feet. Reckoning an engine of 73 inches diameter of cylinder, and 7 feet length of stoke at 217 horses power, the area of fire grate in the most judiciously constructed marine flue boilers, such as that of the Great Western, is .46 of a square foot—the engine working expansively from one-third to one-fourth of the stroke. The heating surface in this boiler is 8.8 square feet per horse power, so that the heating surface is 19 times the area of the grate surface; and if the consumption of fuel be taken at 6lbs. per horse power per hour, as it was very nearly, there will be about 13lbs. of coal consumed on each square foot of fire grate. In the tubular boilers latterly introduced into steam vessels the proportions are somewhat different. The boilers of the *Braganza* reckoning the power of the engines at 289 horses power, have only .39 square feet of fire grate per horse power, while the heating surface is 11.98 square feet per horse power. This is at the rate of 30.71 square feet of heating surface for one square foot of fire grate, and if the consumption be taken at 6 lbs. per horse-power per hour, there will be 15.38 lbs. of coal consumed per hour on each square foot of fire grate. The grate surface per horse-power in the tubular boilers in the *Tagus* is .38 square feet, and the heating surface is 7.73 square feet, which is at the rate of 20.39 square feet of heating surface per square foot of grate. In the tubular boilers of the *Sydenham*, the proportion is 21.64 square feet of heating surface per foot of grate, but the proportion of grate per horse-power is larger than in the *Tagus*. In the tubular boilers of the *Ocean* steamer (232 horse-power) the grate surface per horse-power is .59 square feet, the heating surface 13.48 square feet per horse-power, which gives 22.84 square feet of heating surface per square foot of grate. The consumption of coal per horse-power per hour is 8.68 lbs. which is at the rate of 14.71 lbs. per square foot of fire grate per hour; but if for the sake of comparing it with the previous examples the consumption be taken at 6 lbs. per horse-power per hour, as would be the case if the engine were worked more expansively, then the consumption of coal on each square foot of fire grate would be 10.17 lbs. These particulars may be tabulated thus:—

| | Floating engine per horse power. | Grate surface per horse power. | Floating surface per square foot of grate surface. |
|---|---|---|---|
| Great Western...Flue boilers ... | 8.8 | .46 | 19 |
| Braganza .........Tubular ......... | 11.98 | .39 | 30.71 |
| Tagus ............Tubular ......... | 7.73 | .38 | 20.39 |
| Ocean ............Tubular ......... | 13.48 | .59 | 22.84 |
| Sydenham.........Tubular ......... | | | 21.64 |

The amount of steam room in boilers varies very much. Waggon boilers of 2 horses power, have about 8 cubic feet of steam room per horse power, and the proportion diminishes as the size of the boiler is increased, until at 45 horse power the steam room is about 5 cubic feet per horse power. In the tubular boilers of marine engines, the proportion is less than this. The tubular boilers of the *Braganza*, have about 3.44 cubic feet of steam room per horse-power; those of the *Ocean* 2.58 cubic feet, while some have as little as 1.79 cubic feet; but these last are addicted to priming. The proportions of half a square foot of grate surface $10\frac{1}{2}$ to $11\frac{1}{2}$ square feet of heating surface, and 3 cubic feet of steam room per horse-power seems to answer very well for tubular boilers when the engines work expansively through one-third or one-fourth of the stroke. In these estimations, the whole of the tube surface is reckoned as effective surface.

55. In what way do you estimate the horse-power in giving these proportions?—By the following rule: multiply the square of the diameter of the cylinder in inches, by the cube root of the stroke in feet, and divide by 47.

56. Does that rule give results corresponding with those fixed by Mr. Watt?—It gives the nominal horse-power, which is about the same as the actual horse-power with the pressure of steam Mr. Watt used. It is clear, however, that an engine of any given dimensions, will work with more or less power as the pressure of the steam is increased or diminished, and any statement relative to the proportions of an engine, to be constant, must have reference to the nominal power. The amount of the power exerted by an engine, or the effective horse-power, may be ascertained as follows:—multiply the area of the piston in square inches by the effective pressure per square inch upon it, in pounds, and by the motion of the piston, in feet, per minute; the product divided by 33,000 is the horse-power: or we may square the diameter of the cylinder, multiply by the effective pressure per square inch, and by the motion of the piston in feet, per minute, and divide the product by 42,017, which gives the same result.

57. Then a horse-power is represented by a load of 33,000 lbs. raised one foot high in the minute?—Yes; that is the measure, and it is equal to 528 cubic feet of water raised through the same distance. Mr. Watt, when he first applied his engines to perform work that had previously been performed by horses, felt that some such unit as a horse power would be convenient in enabling him to estimate the size of engine required. He therefore made experiments to ascertain the weight that might be lifted per minute by the strongest London horses, and found it on the average to be 33,000lbs. raised through one foot in the minute. It is only the strongest horses, however, that can lift so much; and Mr. Smeaton had previously found that 22,000 lbs. raised one foot high in the minute is as good a performance as can be had from horses of average strength working eight hours a day. Mr. Watt, however, appears to have been desirous that his engines should exceed rather than fall short of their nominal power, and therefore fixed upon a larger performance. In modern engines the mechanical efficacy of the dimension of engine answering to a horse-power has been greatly increased, so that every horse-power of an engine rated at 100 horses, may lift 66,000 pounds, one foot high in the minute, instead of 33,000 A nominal horse-power, therefore, is now merely a commercial unit by which engines are bought or described, but the dimension of engine answerable to this nominal power, is that represented by the actual power in Watt's original engines.

58. At what amount did Mr. Watt estimate the effective pressure upon the piston?—At 6.8 lbs. on the square inch for engines of 4, and under 4 horses-power, up to 6.94 lbs. on the square inch for engines of 100 horses-power. Messrs. Boulton and Watt now estimate the pressure at 7 lbs. per square inch; and the rule for determining the nominal power by multiplying the square of the diameter of cylinder in inches by the length of the stroke in feet, and dividing by 47, gives results very nearly corresponding with the proportions they employ. The rule takes no cognizance of the slight dffierence in the effective pressure on the piston in the case of different powers; but inasmuch as the question of nominal horse-power is no longer a scientific but a commercial one, it appears expedient to free it from scientific refinements that are no longer necessary. The rule makes the power of small engines somewhat greater than according to Mr. Watt's proportion, but this consideration it is conceived, contributes to uniformity in the standard, as small engines are produced at certainly no less proportionate cost than larger engines.

59. What is the nature of combustion?—Combustion is energetic chemical combination, or in other words the mutual neutralization of opposing electricities. When coal is brought to a high temperature it acquires a strong affinity for oxygen: and combination with oxygen will produce more than sufficient heat to maintain the original temperature.

60. Does air consist of oxygen?—Air consists of oxygen and nitrogen mixed together in the proportion of $3\frac{1}{2}$ lbs. of nitrogen to one pound of oxygen. Every pound of coal requires about two pounds of oxygen for its saturation; and therefore, for every pound of coal burned, seven pounds of nitrogen must pass through the fire, supposing all the oxygen to enter into combination. In practice, however, this perfection of combination does not exist: about one-third of the oxygen passes through the fire without entering into combination, so that about 12 lbs. of air are required for every pound of coal burned: 12 lbs. of air are about 160 cubic feet.

61. What rule have you for the strength of boilers?—It is found by experiments upon the strength of iron, that a bar one inch square will bear a load of from 55,000 to 60,000 lbs. A section of boiler plate, of which the area is equal to a square inch, will bear the same strain, but iron will not bear this strain without permanent derangement of structure. The strain which malleable iron will withstand without permanent derangement

of structure is about 18,000 lbs. per square inch of sectional area; cast iron bearing about 15,000, and tempered steel about 45,000 lbs. under the same circumstances.

## ART. IV.—THE TENDENCIES OF ART.

ARTISTS are bad political economists: they persist in producing things people do not want, and declaim against want of patronage when the secret of the evil is their own want of docility. Historical pictures are little wanted in this country, and therefore do painters fret and repine instead of turning to the production of such works as *are* wanted; and a gulf lies between the artist and the artizan, with on the one side a penury of capacity, and on the other a penury of employment. If artists would only deign to make themselves useful in their day and generation, they would have no reason to complain of a dearth of patronage. They must come down from their stilts and take their position in the van of industrial art, and they will reap an abundant harvest both of profit and renown. Precedent is the rust of art—a canker that will dim the lustre of the most precious metal; and instead of imitating Raphael, and Coreggio—producing insipidities, which are useless for every purpose, they would manifest a wiser and a nobler ambition in taking up industrial art, where it now stands with the desire of carrying it to the highest perfection of which it is susceptible. The expediency of such a course is now beginning to be apparent to intelligent artists. At a late meeting of the Institute of Fine Arts, a paper of considerable interest was read by Mr. Buss, on the "Union of Historical and Decorative Art," with reference to the enlarged prospect opened up to the artist in this country by even the limited encouragement bestowed under the auspices of the Royal Commissioners. After adverting to the use of historical painting for interior decoration, in Italy, Germany, and France, Mr. Buss spoke of its application to the exteriors of buildings—for which purpose mosaic, ægrafito or scratched work, fresco, and oil painting are all available; and having exhibited some views of the decorated front of a house in the market place of Verona, and described the works of art to be seen on the exterior of St. Mark's, at Venice, and in other Italian cities, he alluded to the very rare examples of the kind which the streets of London exhibit. Arguing on the absurdity of English artists considering it derogatory to the dignity of their art to engage in what may be termed sign-painting, he mentioned a house in Oxford-street, with Moorish decorations, after a design furnished by Mr. Owen Jones,—and one in Great Marlborough-street, painted externally with arabesques in fresco by Rigaud, the Academician. At Munich, similar decorations have been exposed to the effects of the weather for long periods without sustaining any injury. It was insisted on that the painter should be consulted on the general arrangements, internal and external, of buildings—an innovation to which many architects would probably object, but which appears to us to have many considerations to recommend it. An architect is a composite being—half artist, and half engineer. In the engineering field, the civil engineer far outstrips him, and in the artistic field, the painter and sculptor would, if they had the opportunity, probably show an equal superiority. The engineer, however, has had no precedent constantly before his eyes to quell his imagination, and he therefore marches ou in the career of greatness; whereas the artist looks to Titian, and Michael Angelo, instead of to nature, and considers more what his idols did, than what is at present wanted. If the artist can only free himself from these antique shackles, and condescend to satisfy the wants of his time, he may rise to as high a position as the engineer at present occupies; may improve the public taste, and earn a reputation such as no other line of conduct can secure.

## ART. V.—HASTIE'S DIRECT ACTION ENGINE.

THIS engine, of which we now give a drawing, is somewhat similar to Bury's, but the connecting rods which are attached to the lower end of the side rods are carried up to a crank on either side of the cylinder instead of being joined at the top, and communicating with a single crank. The drawing will show the arrangements for working the air pump, &c., into which details it is therefore unnecessary to enter. We may take another opportunity of making some observations on the merits of this engine.

## ART. VI.—NOTES OF THE MONTH.

*An Aerial Tunnel.*—Mr. Robert Stephenson has presented a report to the directors of the Chester and Holyhead railway, relative to the bridge which is to carry that railway over the Menai Straits, and he recommends the adoption of a square wrought iron tube, or tunnel, 450 feet long, hung over the sea at a sufficient elevation to enable ships to sail beneath it. Mr. Stephenson had previously proposed a cast-iron bridge of two arches, but a structure of that kind was objected to by the Admiralty, as impeding the navigation of the Straits. The tunnel will be in effect a hollow beam, 450 feet long, 30 feet deep in the centre, and 15 feet wide, and the trains will pass through the centre of it. Would it not be preferable to have made the trains pass along the top? The beam might then consist of open truss work, arranged to give a maximum of strength without opposing much surface to be acted on by the wind. If the wind presses with a force of 30lbs on the square foot, as in violent storms it will sometimes do, the side pressure upon the tunnel will be upwards of 180 tons. Mr. Stephenson's name, however, carries with it the conviction that what he undertakes he will successfully execute. His report we publish at length in another page, and to it we refer the reader for the details of the scheme.

*Dr. Ritterbrand's Process for Preventing Incrustation in Boilers.*—This project respecting which we offered some remarks on a former occasion has been brought under the notice of the Institution of Civil Engineers, and Mr. Gooch took the opportunity of warmly commending the efficacy and advantage of the invention. In locomotive engines, Mr. Gooch alleged the innovation had been attended with the happiest results, while in the boilers of marine engines, its success had been quite as remarkable. It would have been more satisfactory in our judgment had these praises been awarded by any other person than Mr. Gooch, who, as we are told, is a partner in Dr. Ritterbrand's patent, and has an obvious interest, therefore, in setting off the perfection of his wares. We are willing to believe, however, that the introduction of sal ammoniac into boilers prevents the deposition of scale, but we hold this belief to be reconcilable with a considerable scepticism of the practical utility of the application. The best umpire in all such cases of disputed benefit is time, and the superfine devices of mere men of science may safely be left to the adjudication of that inflexible arbitrator; nevertheless we shall, in the present instance, state the more prominent of the doubts which occur to us at the moment.

The scale of boilers at the time of its deposition consists chiefly of carbonate of lime, which does not adhere to the boiler with much tenacity, but by the continued action of heat it is both indurated and changed in its chemical composition, and scale subjected to such influences will be found to be partly composed of sulphate of lime. The carbonate of lime of which the scale is originally formed, exists previous to its deposition in the shape of an impalpable powder, and if the boiler be blown off before it subsides and concretes there will be no scale worth mention formed in the boiler. If collecting vessels be used, the carbonate of lime will collect within them in the form of fine mortar. In Lancashire collecting vessels, within the boilers of factory engines are largely used, and with success, but our present remarks have reference to salt water, which possesses sufficient uniformity of composition to render applicable a general chemical agent. All intelligent steam boat engineers know that they can keep their boilers free from scale without difficulty, by large blowing off, and if this be so, wherein can be the benefit of the medicament proposed by Dr. Ritterbrand? It may, indeed, be maintained that, by large blowing off, a considerable amount of heat is wasted, which, by Dr. Ritterbrand's process is saved; but it is equally saved by setting sheet iron collecting vessels within the boiler which accomplish their function without the trouble or expense incidental to the periodical introduction of a fresh dose of muriate of ammonia into the boiler. However effectual the muriate of ammonia may be supposed to be, it cannot obviate the necessity of changing the water in the boilers sometimes. The boilers must still be blown out though it may be at longer intervals, but can such a change be of sufficient benefit to justify the expense even if there were no expence of patent license to be defrayed? We say nothing of the inconvenience of introducing the ammonia into the boiler of a steam vessel in this comparison; it could not be introduced into the hot well, but would require to be dissolved in a tank, and then forced into the boiler by a pump provided for the pnrpose.

These considerations, however, only show the uselessness of the plan in the case we have considered. We do not think it difficult to go a step further and shew that it may be pernicious. The rationale of the process we take to be, that the muriatic acid of the muriate of ammonia unites with the lime of the carbonate of lime, leaving the carbonic acid to unite with the ammonia, forming carbonate or subcarbonate of ammonia. This it is well known is a very volatile salt, and it will pass with the steam through the engine, working all the destruction upon its internal parts that ammonia is capable of accomplishing. We care not whether or not the precise rationale is that which we have supposed; ammonia, if in any considerable quantity in the boiler will find its way into the engine just as it passes over with the water in the operations of gas making, and if it passes through the engine, it must be productive of the pernicious effects which are so well known to be operative upon gas meters and other gas apparatus. It would be a symptom of some other quality than courage to run the risk of spoiling an engine for the sake of remedying an evil in boilers which does not exist, or rather which is remediable by simpler means long successfully practised and which are known to be safe.

*Education of the Poor.*—The amiable and popular Charles Dickens has addressed a letter to the *Daily News*, in which he calls public attention to some laudable efforts which have been making for some time back to impart some slight knowledge of morality and religion to the most neglected and most depraved of the inhabitants of the metropolis: night schools have been opened in some of the most wretched quarters of the town, where gratuitous instruction is given to all comers. These schools, several of which have been in operation for the last two years, are known as the 'Ragged Schools,' and they have generally a good attendance of youths and children of both sexes, who are tolerably patient and attentive. The progress of these schools has been very encouraging, although their very existence has been hitherto unknown to the public. Mr. Dickens made an attempt some time since to call the attention of government to them, but without success. It seems to be an unfortunate fatality of the government of this country that no measures can be for one moment entertained unless they are likely to tell in the speech of a minister, or the trickery of electioneering. The sanatory condition of the people was only inquired into after repeated struggles: and the recommendations of the Commission will very probably be allowed to slumber in blue-books, unless some vigorous exhibition of the public opinion compels attention to it. The moral state of the people is as legitimate a subject for inquiry and legislation, and was indeed to some extent elucidated by the evidence given before the Commission, and sufficient evidence exists to justify legislative interference for the prevention, at least, of the moral diseases of the working classes of our population. The truth is beginning to break upon those who alone we fear are likely to exert themselves to abate the evil; the public are beginning to be aware of the vast amount of ignorance, wretchedness, and crime, and are getting some slight apprehension of this economical proposition, that it is much cheaper to educate than to incarcerate, to feed and employ, than to convict and execute. A meeting which lately took place of gentlemen interested in the subject, is, we trust, an indication of the approach of a better and happier state of things

*Decorations of the Opera House.*—Her Majesty's theatre has undergone a renovation in the interior decorations. The style which has been adopted is that which was employed by Raffaelle in the Italian palaces to the exclusion of that of Louis Quatorze. The lower tier of boxes has the front divided into twenty panels, separated by twenty-one medallions and arabesque devices, the former taken from the Loggia of the Vatican; the top and bottom are enclosed by arabesque borders. The subjects of the panels and medallions are from the ruins of Pompeii, Raffaelle, Annibal Carracci, Giulio Romano, and other sources. The second tier is painted in less striking colours, but is similarly divided, the circles containing representations of Apollo and the Muses, and the panels bands of cupids, playing and dancing. The remaining tiers are more lightly decorated. The composition of the ceiling has been taken from the Villa Madonna, which was designed by Raffaelle and Giulio Romano; and the Aurora of Guido, and the Elements by Albuno, have been added to enhance the effect. The proscenium has also been repainted. Besides these alterations, which have been made by able artists, various minor ones have been made, which will give a uniformity of character to the house, and increase the comforts of its visitants.

*Mr. Lucas and Professor Donaldson.*—Mr. Luacs, whose model of the Parthenon has lately attracted considerable attention, has been attacked by Mr. Donaldson, on account of alleged inaccuracies in that work. Mr. Donaldson says, that "In the model of the Parthenon in its dilapidated state, Mr. Lucas has erroneously represented on the architrave over the columns of the posticum, the fillet caps over the guttæ. He has not placed them at the angles, and has continued them along the flanks. Mr. Lucas has continued the antæ cap mouldings along the wall of the Posticum, and along the flank wall of the cella, and has represented cornices on the inner face of the cella wall where they do not exist, nor according to the most probable mode of restoration, ever could exist." Then there is a mistake in the number of steps, and a mistake in the size of the door, and the omission of some railings and other things of that description. Now it cannot be denied that any model professing to be the representation of a building, whether ancient or modern, ought to be an accurate one, and Mr. Lucas' work is open to exception, if he has misplaced the mouldings or multiplied the steps; but Mr. Donaldson must surely have peculiar ideas of the nature of the architect's function, when he thinks it necessary to protest against Mr. Lucas' heresies, "to vindicate the professional character of English architects." Dces then the professional character of English architects hang on their exact knowledge of every moulding and hand-rail of the Parthenon? If so, it rests upon a most precarious basis; the manufacture of Parthenons is not necessary at the present day, and the claim to professional skill an account of such antiquarian proficiency is much as if an engineer were to rest his pretensions on an acquaintance with every pipe and rivet in the Marquis of Worcester's engine. What is the Parthenon to us? Is human progress to be for ever stopped by the obstruction of these worn out antiquities? Has architecture improved since thay have been so diligently studied, or do architects occupy a more important position now than formerly? Mr. Donaldson does not see far, if he does not see that the pertinacious adherence of architects to the old fashioned forms must bring ruin upon the profession: already the more important works in construction have passed into the hands of the civil engineer who acknowledges none of the fetters antiquity imposes. In the department of fine art, similar adventure is beginning to be manifested; and what is to become of the architect, if, both in art and construction he is outrun? To maintain its existence, architecture must give up the imitation of ancient things: let antiquaries investigate old mouldings, and spend their lives in frivolous inquiry. Architects have other things to do, and they must march with the times or be deserted.

*Manning the Navy.*—It is stated that with some vessels great difficulty is experienced in procuring a sufficient complement of men. This might be alarming, if at the same time there were not an equal facility in manning other vessels. The matter is simply this; some officers have the good sense and the good feeling to treat their men as reasonable and intelligent creatures, while others seem to suppose that some men are born with epaulettes on their shoulders, and others with blue jackets; the former having a right divine to act as it seemeth good in their own eyes, and the latter being under a most religious obligation to knock under to their born superiors. We think it would conduce much to the benefit of the service if these high flown gentry would abate their extravagant notions, and look upon themselves as being temporarily entrusted with the command of men, many of whom are every whit as good as themselves, but who are content to become not their servants but the servants of the public, not for their pleasure, but for the general good. If those in command will not learn these lessons, they will certainly be taught them in some less agreeable manner. The navy suffers much from the aversion which exists to the service, and the best way of insuring a good supply of seamen is to render the service popular by the appointment of good officers who never fail to get good men.

*Short Hours of Labour.*—The question of shortening the hours of labour has had some discussion in parliament, where it was introduced by Lord Ashley, who, however, resigned his seat before any discussion was come to. In the course of the debate his lordship stated that the advantage of short hours had been tested by Mr. Gardner, of Preston, who had found that the quantity of work done was not diminished thereby. Mr. Bright endeavoured to break the force of this example, by stating that the shortening of the labour hours was merely apparent, as corresponding reductions had been made in the meal hours, and the engines had been quickened so as to produce the same amount of work before. The operatives of Mr. Gardner have since met in public and denied most explicitly all the assertions of Mr. Bright. The various speakers at the meeting bore testimony to the lightness of the yoke which Mr. Gardner imposed, and maintained that their meal hours were never infringed upon, that they worked harder than formerly, because, they worked with kindly and grateful feelings, and they resented the statements of Mr. Bright as an insult to themselves as well as their employer. Some well merited censure was also passed upon Mr. Bright for his scoffing remarks upon the factory cripples. The reputation of Mr. Bright can scarcely be benefited by the unqualified contradiction which his assertions have received, and it will be well for him if he take warning and relinquish his opposition to measures which are so well adapted to promote the happiness and comfort of the factory operatives, else his sympathy with them, and his commisseration of the agricultural labourers will in all probability come to be regarded as so many rhetorical exhibitions, and the sincerity not only of himself, but of his coadjutors of the League will fall into not unmerited suspicion. The League has had the effect of calling attention to the selfishness of landowners, but the mill-owners must not forget that they also are vulnerable, and if they think to evade the claims of their work people to enfranchisement, by the cry of free trade, they will find they have sadly miscalculated; for if it will not enable the operative to live in some degree of comfort, and give him time for mental and moral improvement, it has failed in its object, and other measures must be tried. Mr. John Bright, to the contrary, notwithstanding. We are happy to find, however, that the disposition exists among mill-owners to reduce the hours of labour, as evinced by a recent meeting of master spinners at Manchester, when the general feeling is said to have been favourable to diminishing the hours of work from twelve to eleven hours a day, contingent upon the concession of free trade. The masons of Liverpool have also had their attention directed to the question, and a meeting lately held there carried resolutions to the effect, that the moral, mental, and physical improvement of masons would be best promoted by the reduction of the hours of labour in the summer months to nine hours a day, instead of an advance of wages. The prevalence of this feeling will ensure success.

*Temple of Industrial Art.*—Exhibitions of the products of industry have come into great favour in most of the continental states, the rulers of which have lately given great encouragements to the manufacturing industry of their subjects by the distribution of rewards and honours. The King of Bavaria, who is so devoted an admirer and patron of the arts, has been the first to construct a permanent edifice for the reception of the products of industrial art. It was designed by Ziebland; its form is a parallelogram divided into a vestibule, and seven apartments of different sizes, lighted from the top. Two other rooms lighted by windows are intended for paintings on glass, and two corridors similarly lighted are intended to be used for drawings and other small objects. The rooms have an aggregate area of about eighteen hundred square yards, and their size varies from twenty-four to thirty-four feet. The floors are covered with oak parquetting, the doors are painted in imitation of walnut wood, and the walls are similarly wainscoated, above which they are painted of a dull colour relieved by connecting pilastres between which there are arabesque decorations. The ceilings are coffered and adorned with paintings, and the light is admitted equally into every part of the rooms. Beneath the exhibition room, there is a place for receiving and unpacking articles intended for exhibition, and rooms for the resident officials, and above them are apartments for the assistants necessary at the periods of exhibition. The roof is of iron. The principal entrance of this building has a Corinthian portico, with twenty. one steps. There are two wings with pilastres, on a base of the same height as the steps of the portico. The façade is sculptured with figures representing Bavaria distributing rewards of crowns to the arts. On the summit is a phœnix, and on the extremities of the pediment are two lions. The encouragement of the arts has been greatly neglected in this country, and it would contribute, we conceive, not merely to the development of talent but also to the stability of our nobles, if the peerage were made accessible to those who have distinguished themselves in any way by their public services, instead of reserving such honours exclusively for warriors and lawyers.

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## ART. VII.—NOVELTIES IN ART AND SCIENCE.

*Electro Culture.*—An account of some experiments on the Electro-Culture of farm crops, has been read before the Royal Society by Mr. Sturgeon. Grass grown on a parallelogram of land, 55 yards long by 22 yards wide, in closed by underground wires, was found to be much more abundant than in any other part of the field; especially in a plot upwards of 50 yards long, whose breadth was within the wires, and nearly at right angles to the axis of the parallelogram. This plot of grass was principally on the western side of the wires, and extended bnt a very little way on the eastern side. The axis of the wire-inclosed parallelogram was in the magnetic meridian. This important subject is now receiving much attention, and we know of none that deserves it more.

*Barrage of the Nile.*—This scheme for increasing the arable land of Egypt, by extending the influence of the periodical inundation, which has been several times commenced and suspended, is again in abeyance. The undertaking it is said presents greater difficulties than was expected, as the completed plans exhibit an immense amount of labour and capital required. It is, moreover, apprehended that the river thus hemmed in and led away from its previous source, may form in some places an altogether new bed, or that the sea may encroach on the Delta, where considerable alterations are contemplated. It is said, further, that even the arable land now at hand is not adequately cultivated for want of hands, and that the land gained by these stupendous hydraulic operations will be of no avail whatever. The Pasha in all his operations appears to lose sight of the resources of the country, which is impoverished to carry into effect grand schemes that it can ill afford.

*Magneto-Atmospheric Railway.*—Messrs. Conder and Taylor have taken out a patent for connecting the piston of an atmospheric railway with the train by means of a magnet, which obviates the necessity of a slit in the pipe. This plan was suggested by the Club a year ago, and will be found noticed 'n the *Artizan*, No. 1, new series, and page 5.

*The Phœnician Language.*—We seem to be fast advancing towards a solution of lingual obscurities; General Duvivier, it appears, who was for some time in Algeria, had collected there various inscriptions similar to those which are commonly called Phenician letters, and which are found in Spain, Africa, and the Islands of the Mediterranean. After his return to France, he engaged in a careful study of his materials, and now asserts that he has penetrated their mysteries, although not yet quite prepared to lay his discoveries before the world. This premature announcement has been caused by his appointment to the Madagascar expedition which has interrupted his studies, and unwilling to risk the loss of the knowledge which he has obtained, he has published translations of some inscriptions, although compelled to defer a detailed account of his method of interpretation. These inscriptions have hitherto been supposed to be little more than an enumeration of proper names, but if the general's views be correct, they will furnish much interesting information respecting the ancient merchants of the world. It is now said that the Madagascar expedition has been abandoned, and if this be correct we may shortly expect to hear more details of General Duvivier's discoveries.

*Suspension Aqueduct on the Pennsylvanian Canal.*—This work, which is hung by means of wire cable tied by anchor chains, consists of 7 spans, of 160 feet each, from centre to centre of pier. The trunk for the water is of wood, 1140 feet long, 14 feet wide at bottom, $16\frac{1}{2}$ feet on top, the sides $8\frac{1}{2}$ feet deep, and is composed of a *double* course of $2\frac{1}{2}$ inch white pine plank, laid diagonally at right angles. The bottom of the trunk rests upon transverse beams arranged in pairs, four feet apart; between these, the posts which support the sides of the trunk are let in with dove-tailed tenons, secured by bolts. The outside posts, which support the sidewalk and tow-path, incline outwards, and are connected with the beams in a similar manner. Each trunk-post is held by two braces, $2\frac{1}{2}$ + 10 inch, and connected with the outside posts by a double joist of $2\frac{1}{2}$ + 10. The trunk-posts are 7 inches square on top, and 7 + 14 at the heel; the transverse beams are 27 feet long and 16 + 6 inches; the space between two adjoining is 4 inches. Each pair of beams is supported on each side of the trunk by a double suspension rod of $1\frac{1}{8}$th inch round iron, bent in the shape of a stirrup, and mounted on a small cast-iron saddle, which rests on the cable. These saddles are connected on the top of the cables, by links, which diminish in size from the pier towards the centre. The pyramids which support the cables are constructed of three blocks of a durable, coarse, hard-grained sand-stone, rise 5 feet above the level of the side-walk and tow-path, and measure 3 + 5 feet on top, and 4 + $6\frac{1}{2}$ feet at base.

The caps which cover the saddles and cables on the pyramids rise 3 feet above the inside or trunk railing, and would obstruct the free passage of the tow-line; but this is obviated by an iron rod which passes over the top of the cap, and forms a gradual slope down to the railing on each side of the pyramid.

The wire cables are each 7 inches in diameter, and are constructed in one piece from shore to shore, (1175 feet) of 1900 wires of $\frac{1}{8}$th inch thickness, which are laid parallel to each other. Great care has been taken to insure an equal tension of the wires. Oxidation is guarded against by a varnish applied to each wire separately. The anchor chains below ground are imbedded and completely surrounded by cement. In the construction of the masonry, this material and common lime mortar have been abundantly applied. Where the cables rest on the saddles, their size is increased at two points by introducing short wires and thus forming swells, which fit into corresponding recesses of the casting. Between these swells, the cable is forcibly pressed down by three sets of strong iron wedges, driven through openings which are cast in the side of the saddle.

The following are the chief dimensions—

| | |
|---|---|
| Aggregate weight of both cables | 110 tons. |
| Section of 4 feet of water in trunk | 59 sup. feet. |
| Total weight of water in aqueduct | 2,100 tons. |
| „ „ „ one span | 295 „ |
| Weight of one span, including all | 420 „ |
| Aggregate number of wires in both cables | 3,800. |
| Aggregate solid section of both cables | 53 sup. inches. |
| „ „ „ anchor chains | 72 |
| Deflection of cables | 14 feet 6 inches. |
| Elevation of pyramids above piers | 16 feet 6 „ |
| Weight of water in 1 span *between* piers | 275 tons. |
| Tension of cables resulting from this weight | 392 „ |
| Tension of one single wire | 206 lbs. |
| Average ultimate strength of one wire | 1,100 lbs. |
| Ultimate strength of cables | 2,090 tons. |
| Tension resulting from weight of water upon 1 solid square inch of wire cable | 14,800 lbs. |
| Tension resulting from weight of water upon 1 square inch of anchor chains | 11,000 lbs. |
| Pressure resulting from weight of water upon 1 pyramid. | $1,37\frac{1}{2}$ tons. |
| „ „ „ „ „ 1 sup. foot. | 18,400 lbs. |

*Structure of the Portland Vase.*—At a late meeting of the Society of Arts, Mr. Doubleday exhibited a number of specimens of ancient glass manufactures, as illustrative of the theory which he deduces as the true principle of the construction of the Portlaad vase. He imagines the blue body of the vase to have been first made, and then covered with a thin coating of semi-transparent white glass, by dipping it into that material while in a state of fusion. The vase, he supposes, was next placed in the hands of the artist, who, by a process similar to cameo-cutting or gem-engraving, produced the beautiful designs in relief which now adorn its surface. He also stated, in confirmation of his idea of the mode in which the vase was constructed, that while engaged in repairing it, he observed that there existed a coat of white glass underneath the handles, at the points at which they are united to the vase. Mr. Pellatt and Mr. Christie, who are practically acquainted with the manufacture and working of glass, concurred with Mr. Doubleday in the view he had taken of its construction; but, from their statements, it would appear that, after all, the merit of the work rests with the artist, as there is no difficulty at the present day in manufacturing similar materials. Mr. Doubleday stated that the bottom of the vase did not originally belong to it; and, from the style in which it is executed, he should consider that there is a difference of 200 years in the date of their execution.

*Indian Corn a substitute for Potatoes.*—It appears that the government, besides projecting the removal of restrictive duties upon the importation of food, took measures during the recess for the mitigation of famine by the purchase of a large quantity of maize. The editor of the *Times* states, that samples of bread made with maize flour, alone, and also mixed with wheaten flour, which were forwarded to him, are light and of good quality and flavour. Father Mathew also states in a letter to the *Cork Examiner*, that he has tried bread made with maize flour alone, and also mixed with wheat-meal and oatmeal, and he prefers that made from the unmixed meal. He has also made stirabout or porridge with the maize meal, and says it is excellent; so that the new article of food may be used in the same way that the people have been accustomed to use oatmeal. Father Mathew anticipates that one good result of the present failure of potatoes, will be to prevent them from being depended upon as the sole food of the people; and the statement that the produce of the seed in the slightest degree affected is also diseased seems to augur the necessity of a change of food. He also starts the question, whether the time expended in planting them, in cooking them, aud in procuring the requisite fuel, does not render them in point of fact more expensive an article of food than wheat. We may mention before leaving the subject, that a dish called homminy is made from maize in America, by boiling the shelled grain whole, and seasoning it with salt and onions; and, this too, the worthy Father has tried and recommended to his countrymen.

*Glass-Making.*—This manufacture has received a great impulse from the late reduction of the duty. Works are being enlarged, and good dividends are gladdening proprietors. The French government with its usual readiness to promote the arts among its subjects, has offered premiums for improvements in glass making. It is said that great improvements have been made recently by the manager of Bhoisy-le-Roi, a large glass manufactory. The following are said to be the proportions of materials employed. For flint glass:—sand 43.5, oxide of lead 43.5, carbonate of potash 10, nitrate of potash 3▭100 portions. For crown glass:—silicum 60, carbonate of Soda (at 90 deg.) 25, carbonate of lime 14, arsenic 1▭100. The carbonate of soda tends to make the glass readily absorb moisture from the atmosphere, which can only be obviated by a lengthened fusion, or by substituting, at least partially, borate of soda. Glass made by carbonate of potash instead of soda is pure, and less subject to de-vitrification, but its inferior density unfits it for optical purposes.

## Art. VIII.—LETTERS TO THE CLUB.

*Architecture the Poetry of Building.*—Ranking as one of the fine arts, the position of architecture as such is very anomalous—its character ambiguous. It does not seem to be clearly understood by any one, not even by its own followers, what it is that elevates architecture above the merely material and mechanical into the sphere of art. On the contrary, because indispensable to it, the material and mechanical are made to appear its very essence—not the means alone by which it effects its purposes and exhibits itself, but the art *per se.* The body is taken for the soul, the substance for the animating intelligence; which serious mistake—the cause of so much perplexity and error—instead of being sedulously guarded against, is rather inculcated and confirmed by the manuer in which architecture is spoken of by those who take upon them to speak of it, and assert its claims and pretensions as a fine art. The definitions given of it are both very clumsy and wide of the mark; the one that would be exact, explicit, and free from all ambiguity, is that architecture is The Poetry of Building; in other words, is Building treated *æsthetically,* and so as to excite pleasurable emotions in the mind, gratifying that perceptive faculty denominated taste.

Our physical necessities and material wants demand the services of building, whose paramount utility is not to be disputed, it being what we cannot possibly shift without; but they need nothing further than what building alone can accomplish, and it is capable of giving us habitations in which there shall be no lack of commodiousness, comfort, and convenience, but which are at the same time altogether destitute of the æsthetic quality. Such quality is not aimed at in building as contradistinguished from architecture, to which it stands in the same relation as prose does to poetry,—or rather as the prosaic does to the poetic and the imagiuative; because, in like manner, as there is a great deal of prose dressed up in the outward trappings of poetry, it is not unusual for mere productions of building, which, by assuming the livery of architecture, equally pretensiously and awkwardly, show only as abortions of the latter art.

Building, whose element and aim are utility, must in the very nature of things, precede and prepare the way for architecture; but the latter does not always follow in consequence, and when starting from the point to which utility had conducted, pursue its own career into the regions of art, where what far exceeds the material and indispeusable becomes indispeusable in turn. Those, therefore, who refer all beauty in architecture to utility, either take up with a very limited and insufficient theory, or give an exceedingly comprehensive meaning indeed to the latter term, rendering it so usefully and accommodatingly elastic for their purpose, that they can stretch it around, and include within it the æsthetic quality also. Yet the latter is assured by something quite distinct from the other—though the two are so far from being incompatible with each other—that in architecture we look for the union of both. We may stop short at utility; but, however far wc may advance beyond it, we must retain it,—at least the semblance of it—even in structures which are intended to be regarded chiefly as creations of art. The building that merely answers its intended purpose and no more,—and a barn or a brewery may do that,—excites no æsthetic interest or cmotion. It does not all address itself to the imagination, but content with the approval it may deserve for the good sense and mechanical ability displayed in it, it makes no claims upon our admiration. The Society of Friends will lend us a comparison to illustrate our meaniug: in dress they stop at the utility point,—that is they do not dress at all; for though their apparel may be the perfection of clothing, and as costume sufficiently distinctive, at least on the part of the females, it is not dress, æsthetically speaking; their attire being a negation of all that exceeds the purpose of clothing and is intended merely to delight the eye.

After this it may safely be left to the reader to judge how it stands with the utility doctrine of some theorists, because, *mutatis mutandis,* the same principle holds good both in regard to architecture and dress, the one being the poetry of building, the other that of clothing. And in like manner as with respect to the latter, mere personal comfort frequently gives way to other considerations; so, too, in architecture, when the regard to convenience and the regard to art happen to pull different ways, one of them must yield more or less to the other; and among such a matter-of-fact people as ourselves, it is generally the latter which is made to do so, and that not so much out of stringent necessity, as from our not studying to produce new modes of beauty, and other combinations of beautiful forms than those we are accustomed to. Instead of so doing, we allow past excellence to prove an obstacle in the way of attaining rival excellence. In architecture, whatever is essentially requisite for usefulness and convenience, ought to be rendered beautiful, at least, pleasing in appearance also; for it was by such plastic process of refinement, eliciting the beautiful out of the necessary, that all the various styles which were admired, arrived at the perfection, and the homogeneousness of character, which render them models of the art for us, but which we unhappily look to as mere patterns or little more.

Notwithstanding that it is almost only by availing himself of circumstances requiring something expressly adapted for the particular occasion, that the architect can display any creative talent as an artist, what is compelled by actual necessity is generally allowed to show itself in most glaring and disagreeable contrast to all the rest; a contrast rendered perhaps, positively ridiculous by the affected precision and scrupulousness of what is unquestionably *orthodox,*—that is, according to precedent, no matter how ill what is taken for precedent may accord with the actual occasion. At the present day we are content to let the art subsist upon what it has accumulated, without endeavonring to add to its former stock, and acquire something fresh to be handed down immediately from ourselves to succeeding generations.

Supposing the inability on the part of architecture to produce any new idea of value to be well founded, and that it has long ago reached the utmost extent which it is capable of proceeding to, that would seem to be matter, if not for shame, for regret,—certainly nothing to be proud of; ncvertheless architects are rather disposed to make a merit of it, virtually renouncing for their art—as an art of design—the power of now affecting more than the mechanical repetition of what, when originally produced, was the operation of genius or creative taste. In architecture, the most direct and barefaced plagiarism, is rather made a merit of than the reverse; and so far from being encouraged, every attempt at emancipation from the trammels of prescribed though quite arbitrary rules, is met by obstinate prejudice, and the sullen predetermination not to tolerate anything that aims at originality,—whatever does so being without further inquiry branded at once as the "new-fangled" or stigmatized, by some other depreciating epithet that takes upon itself the office of criticism, deciding off-hand without the tedious process of discussion. For the restrictions they have imposed upon it the art has mainly to thank architects themselves, whose limited views of it, and where doctrines, have caused the study of it to be looked upon as being altogether technical on the one hand, and historical on the other.

It is in this latter character alone that architecture is taken up by that section of the public which seems to exert itself most industriously—at least most ostentatiously in its behalf. Well-versed in its history—a sort of proficiency to be attained by mere application and dint of reading—they insist upon strict adherence to *precedent,* no matter whether it be Grecian, Gothic, or any other style that is followed; for so long as the style professed be but followed undeviatingly they can follow too, and keep pace with all that is in a design; having an easy, certain, and as they think infallible standard, namely, that of precedent, by which to judge and pronounce decisively and safely; not the slightest suspicion being entertaiued by them that widcly altered circumstances may demand, at least admit of, what is not sanctioned by previous example in former times; or that what was proper and suitable in its time, may at the present time be no better than pedantical affectation.

What with the mechanical, the technical, and the historical study of architecture, hardly any account has been taken of its æsthetic powers, except as far as it has been necessary to exalt them for the purpose of magnifying and claiming exclusive admiration of what has been achieved by the art at former periods, when, be it remarked, it was allowed to exercise itself as such, aud to put forth its energies uncramped by formal theories, and by rules not only arbitrarily imposed, but frequently in conflict with principles, as the latter ought now to be applied. If architects of necessity now must be, or are not permitted to be, more than mere copyists, it is rather inconsistent—in fact bespeaks ignorance of art—to expect from them the manifestation of artistical vigour and fecling.

Betwecn the merely technical on the one hand, and the merely archæological and historical, on the other, the claims of architecture upon the public as a fine art, ministering to their enjoyment, have been so grievicusly overlooked that the indifference and ignorance which prevail in regard to it are not at all to be wondered at. What have professional writers ever done to recommeud architecture to the general public? They have never written except to their own class, or to the few—the one in a thousand—who have turued their attention to the study. They are far more ready to reproach the ignorance of architecture which so extensively prevails even among the otherwise well informed, than to assist in removing it. Either they themselves do not understand what sort of instruction the public require, or they do not care to communicate it. The jealous spirit of Freemasonry still hovers over, haunts, and influences professional men, not only to the injury of the art itself, hut to the disadvantage of those who practice it. The consequences of their mistaken policy are felt by them almost daily, it being a general and certainly not unfounded complaint that even those whose influence and position in society give them a controlling power over the destinies of the art, it heing they who decide and therefore decree what our puhlic edifices shall he—whether works to he proud of or the contrary,—even they are very seldom adequately qualified for the important trust they undertake. No hetter acquainted than others with the practical part of architecture, they are, perhaps, at the same time, far more ignorant of it as a fine art, than many others among the puhlic; so fatally ignorant, perhaps, as not to suspect their own incompetency, or to be aware of the mischief they may occasion. Be their intentions ever so honest, those who have never given any study to an art cannot possibly consult its interests effectively, or, indeed, feel any interest at all about it; though they may dislike the exercise of a little authority in matters of the kind.

Formerly, when almost the entire patronage of architecture and the other fine arts was invested in the church, the ecclesiastical body were conversant with art; encouraged talent accordingly, and freely seconded those magnificent enterprises of art which we are now at length endeavouring in some degree to emulate hy imitation, despairing of being able to rival them hy equal excellence, unhorrowed from them and entirely our own. In this nineteenth century, society is somewhat differently constituted from what it was during the middle ages, and a corresponding change has taken place in art,—at least as regards the sources of patronage. It is not now a distinct and privileged body—*over* the people rather than *of* the people—hut the people itself, that is, the puhlic, to whom art must now look for encouragement, which to he heneficial, must he intelligent also. As far as architecture is concerned, its new patron is hardly so well-informed as its old one was, yet architects themselves do not seem very solicitous for its hecoming hetter informed. If of late years the puhlic have become somewhat better instructed than they used to he, instruction has not proceeded from professional men, though they might, of all others, be considered most interested in diffusing a taste for their art hy promoting the study of it. Professional men, however, do not care to render the study a popular and attractive one; or if such has ever been their aim they have been peculiarly unsuccessful. They do not seem to know what sort of instruction it is that is needed hy the public; hut write more authoritatively then persuasively and convincingly, and dwell more upon the historical and technical than on the æsthetic, touching upon the latter—as far as they do so at all—drily and indistinctly. Besides which, there is a good deal of traditional hahit—not to call it prejudice—in the view they take of their art, which it is not easy for those who have been trained up to it scholastically to divest themselves of. Those who would elevate others to the level of their own intellectual ken, must also condescend to stoop and accommodate themselves to the apprehension of those whom they profess to instruct; yet this is what writers upon architecture almost invariably disregard, even when they do not address themselves exclusively to professional students. The attention of the latter may be commanded, but that of the puhlic must be *enticed*. Hitherto the public have been impressed with the idea that though architecture is one of the Fine Arts, the study of it in that capacity does not helong to them; it being, it seems, what may be enjoyed without any taste for it, or no further training and cultivation of such taste heing required for its development, where the tendency to it exists. Instead of being combatted, this untoward prejudice has been fostered hy equal prejudice and one-sidedness on the part of those who apply to the study professionally, for they have generally studiously concealed, or else very reluctantly admitted, the possihility of the æsthetic and artistic in architecture being fully comprehended and appreciated, without any acquaintance with the technical and operative processes of construction. Still while snch is the doctrine assumed as a general principle, the contrary one is admitted in detail, for whenever their productions are admired, architects are ready enough to give other people credit for discernment, judgment and taste. There are prejudices and contradictions on hoth sides; but they are beginning to be somewhat shaken, and will perhaps in time be removed. Let us hope that more liberal and clearer views will ultimately prevail, and that without distinction of *in* or *out of* the profession, all will co-operate in advancing architecture, and placing it upon the same footing as the other Fine Arts. CANDIDUS.

*Joint Stock Factories.*—As your Journal is peculiarly devoted to the interest and welfare of the artizan, you will perhaps consider a few remarks on the above very important suhject not unworthy insertion. Year after year rolls on over the mechanic's head, he sees the gigantic strides science and skill have made on the manufactures of every description—particularly in improved machinery. He sees masters amassing incalculable wealth, by means of such improvements—and which he is the instrument to produce. He himself yearly increases in knowledge, and yet he is, with all this increased knowledge and consequent power, still a mechanic, working to enrich others; to whose comhination and arbitrary rule he still submits. Is it not extraordinary that in the year 1846 we find the artizan in the same dependent position that he was 50 years ago. How do you account for this anamoly with increased knowledge, increased power—science rapidly progressing—commerce extending—our national hlessings increasing hy means of railways, &c. and every thing hearing the aspect of wealth and greatness, and yet the working man is still a labourer? We know that knowledge is power, but if the possessors of these blessings will not exert them for their own benefit, of what use are they? There does exist an instance or two where a class of trade has risen from its slumher and gone a head of its brethren, and by means of a joint stock fund, purchased for itself independence; then why should not every trade have its own factory? I mean no disrespect to those trades who have relieved themselves from thraldom and tyranny; they, in their calling, are important and respectable, but as compared with some of our artizans are insignificant; and I am sure they will not he displeased hy my saying that they are not to he named in the same age with the engineer and mechanist: to the latter class trade I appeal in particular—why have you not, like your hrother lahourers the type-founders, &c., a factory of your own? Why are you exhausting your-lives, your skill, and your strength, to enrich others, instead of yourselves and your families? Why do you, with the knowledge and power you possess, continue workmen (little hetter than slaves) when you might and can be your own masters? There is scarcely a memher of your numerous and respectable hody, who does not contribute weekly to a cluh or trade society—the amount of course varies, hut I know that many pay 5s. weekly; now just reflect for one moment on the enormous sum these contrihutions amount to at the end of a year—at least £100,000. How many years have each of you paid these suhscriptions, and now that the year 1845 has just closed, what are you the hetter for your contributions? I am fully aware that these contributions are, to a certain extent, heneficial in cases of sickness or accident; it is a great comfort to a deserving man to he ahle to have recourse to a common fund for assistance, and the other objects for which these societies are formed are natural and fair when properly applied; but after all what are these trade cluhs—merely to afford, from year to year, RELIEF in specified cases—it is *temporary relief*, and nothing else—and this fact speaks for itself; for here you are in 1846, workmen and nothing else, applying your energies and skill in your daily lahour, to continue in the same track of drudgery and dependence! Really I am surprised at the fact when I write it—but it is so. Now, instead of contributing weekly for *temporary relief*, suppose you hy the same process purchase at the end of this year great *permanent and lasting benefit*; viz. independence and comparative wealth. The same money you now pay to your cluh (if 5s. per week) would *in 6 months* enahle you to have a factory of your own, and in full work for your own benefit. Be your own masters, and no longer require protection or temporary relief—for you would each work for the benefit of the whole company, and participate equally in the profits derived from your joint labour. If sickness overtakes you, you would still have the profits of the company to depend on for assistance, because you are a partner in those profits. As to any other assistance or protection it would not he required, as you would have destroyed the cause which now calls for it. There would no longer be a circular to the other factories not to employ this or that man—no dismissing you, and preventing you getting work elsewhere hecause you were a witness on hehalf of a poor man who was sought to be crushed by a rich engineer—no refusing to employ a man who had found a friend to patent his invention—no rohbing of the poor man hy adopting his ingenuity, and refusing to remunerate him for it; and then patenting the invention as the discovery of Mr. No-brains, "the eminent engineer;" hut, on the contrary, every encouragement and protection would he afforded to the skilful and ingenious; he would he one of yourselves, and therefore you would reward him, and henefit yourselves also, hy taking an exclusive licence to manufacture according to his improvement—thus remunerating the inventor, and securing to yourselves the full profit of manufacturing the article. In the course of a very few years, you and your families would be in the enjoyment of every comfort this world can afford you. Although I have addressed myself pointedly to the engineer and mechanist, the principle is applicahle, and the means are available to every class of trade. Artizans! let me entreat of you to consider your position, your prospects, and your power—think this suhject over calmly and seriously, and then call your cluhs together and see if, instead of temporary relief, you cannot hy the end of this year obtain permanent benefit—independence and wealth. It is to he done, if you choose to do it; only alter the appropriation of your present suhscriptions, and you *have accomplished* what appears otherwise so formidahle and impossihle. It will not require either of you to pay one sixpence a week more than you do now; make the same payments, and fancy the object the same; hut instead of its heing the same, let the money he invested in the funds, in trustees' names, once a month. I pledge myself that in six months from this day, you could he in FULL work for yourselves. Reflect on these things; act with promptness; and do not let the year 1846 close without finding you masters instead of men!

*Walnut-Tree Walk, Lambeth.* A LABOURER MYSELF.

## Art. IX.—THE SOCIETIES.

Institute of British Architects.—*Jan.* 26.—A letter was read from Herr Zanth (honorary and corresponding member of the Institute), at Stutgard, descriptive of a Casino, now nearly completed from his designs and under his superintendence, for the King of Wirtemburg. The structure—named, after the royal owner, "Wilhelma,"—is of stone, in the Moresque style, the courses of the masonry being coloured white, yellow, and red violet, and covered with copper, partly gilt. It is situated in a winter garden, iu the midst of four conservatories with porticoes, steps, terraces, and parterres;—it consists of a vestibule, an Oriental court, with a fountain, a picture-gallery, a divan, a saloon, an eating-room, and appurtenances, a sleeping and dressing room, and a bath with an arched roof, decorated with pendants. The conservatories and porticoes are of cast-irou, very slender, and richly ornamented:—in the same taste, the conservatories are divided into two aisles, containing various rare flowers, and abut against two pavilions, surmounted by glazed octangular cupolas, for tropical plants;—the entire extent is about 350 fect; at the end of the conservatories the porticoes commence, which form the enclosure of a flower-garden for the private use of the king.

Mr. C. Fowler, Fellow, on presenting some plans and designs relative to the proposed Thames Embankment and Railway Street, read a paper on the projected lines of railway in the metropolis about to be submitted to Parliament. Mr. Fowler stated that he was indebted for most of the details to Mr. Austin, the engineer (Hon. Secretary to the Metropolitan Improvement Society), who had been at considerable pains to prepare a plan of the whole of those lines for which the deposits had been completed. He need scarcely say, that there had been a number of other schemes which had not survived the fatal effects of the panic; of those that remained, it appeared from the plan *that there were twenty-one different lines*, comprising 100 miles of proposed railway, within a circle of five miles from St. Paul's. The spaces scheduled for termini within a circle of fourteen miles of St. Paul's, together with that necessary for the construction of so much of the lines, constitute an area of little short of 200 acres, being equal to that portion of London extending from High-street, Whitechapel, to St. Paul's Cathedral, included between Leadenhall-street, Cornhill, the Poultry, and Cheapside, on the north, and the river Thames on the south: nearly equal to one-third of the City, and little less than one-half of that devastated by the conflagration of 1666. On a moderate calculation, it would involve the destruction of between 9,000 and 10,000 houses, and cause an expenditure, for the purchase of property alone, of about fifteen millions sterling. Mr. Fowler stated, that a memorial on the subject had been forwarded to the First Commissioner of Woods and Forests by the Metropolitan Improvement Society, suggesting that the Metropolitan Improvement Commission, should take the subject into their consideration at an early period; and observed that it behoves not only all professional men, but all who desire to see a right direction given to this extraordinary movement, to assist in promoting the same, in order that this branch of railway communication may be dealt with separately and distinctly, so that a comprehensive and systematic plan may result from what at present is a heap of confusion, arising from the fact that each line has been separately laid down, without reference to, or the knowledge of, what is proposed by any other. Mr. Fowler alluded to the new principle of railway streets, and to the double object that the Thames Embankment and Railway Junction Company had in view of adopting it, namely, that of carrying out a great public improvement in conjunction with the extension of railway communication; likewise that, in the event of government acceding to a separate and distinct consideration of metropolitan lines, an opportunity was at present afforded which could never again occur of effecting the improvement of this great metropolis, as to salubrity, convenience, and splendour, without, probably, any sacrifice on the part of the Government. Mr. Fowler adverted to his design for carrying a railway over London-bridge, as one of the means proposed to connect the lines now terminated at the south end of the bridge with that projected through the City from Hungerford-Market to the Blackwall line. This was proposed to be effected by the addition of arcades; covering the footways with iron framework, extended over the carriage-way to carry the rails: the former of these additions had been projected by him in one of the designs submitted to the Huose of Commons, when the reconstruction of the bridge was under consideration.

Asiatic Society.—*Feb.* 7.—The Secretary read a paper by Dr. Royle, 'On the Culture of Cotton in India, by the American Gentlemen who were engaged by the Indian Government to introduce the American Plants, and Modes of Culture, into the Three Presidencies.' The experiments were begun in the year 1840, in the north-west division of the Bengal Presidency; and though, at first, appearances were favourable, the result was otherwise. The seasons were unusually dry during the years of the experiments, so that all the grain crops of those districts suffered seriously. Dr. Royle, who has himself cultivated the plant in the Saharanpore Botanic Garden, thought that the culture would be successful wherever means of irrigation could be found. The planters were afterwards removed to Gorruckpore and Rungpore; but in those places the young crops were devoured by insects, and burnt up by the drought which followed the rainy season. The experiments are now carrying on in the neighbourhood of Dacca. In the Madras Presidency, there is already much native cotton cultivated; and the Bourbon plant was successfully introduced several years ago. The trials with the American cotton were made in Tinnevelly and Coimbatore. Occasional droughts and storms have here injured the crops in some degree; but upon the whole, the experiment has been successful; and the specimens sent home have been highly approved at Liverpool and Manchester. In the Bombay Presidency, the station of Dharwar was selected. This was the site of an experimental farm, where excellent cotton was raised in the year 1832. In this place the plant appeared to answer perfectly; the cultivation has greatly increased, and the natives have adopted the new plant, finding it more profitable than their own. The gentleman who conducted the culture states that the climate is more like that of Mississipi than any he has seen in India. In this place, 600 acres were planted in 1842; 3,000 in 1843; and 6,000 in 1844. It was calculated that 15,000 acres would be in cultivation in 1845, and that the produce would be above 1,000,000 lbs. Far from deteriorating, the seed appears to improve, and to resume part of its Mexican character. There is, thus, every prospect of a successful cultivation. The approval of the new culture by the natives is a favourable feature: many have bought the gins, and used them in cleaning their own produce; and as many places in the Southern Mahratta country have a climate and soil similar to those of Dharwar, there is little doubt that the Presidency will be the locality of an almost unlimited cultivation of cotton. In reply to queries sent to India by Dr. Royle, it appears that cotton may be bought at Hoobly at $1\frac{1}{4}d.$ per lb., and that by making advances to the ryots, a reduction of 20 to 25 per cent. may be made on that price; also that the cost of clearing and conveying the cotton to the port of shipment would be 1*d*. per lb.

Institution of Civil Engineers.—*February 3rd.*—A paper was read by Mr. W. H. Barlow. "On the existence (practically) of the line of equal horizontal thrust in arches, and the mode of determining it by geometrical construction." The author commenced with a review of former theories on the subject by Gregory, La Hire, Attwood, Coulomb, and Moseley. With the latter he agreed in the principle that the line of resistance must be contained within the thickness of the arch, at every joint, and must meet each joint within the limiting angle of friction. The analogy between the catenary, the line pressure of Whewell, the line of resistance of Moseley, was then pointed out, and the practical existence of the curve of equal horizontal thrust, together with its nature and properties was successfully illustrated by various models. The mode of obtaining the curve by geometrical construction was then shown, together with formulæ for obtaining the necessary thickness of abutments, &c. Numerous drawings and diagrams illustrated this part of the subject. The paper concluded with a reference to the various circumstances in which arches were placed in practice, and the modifications to which theory was consequently subject. It was stated that more than thirty bridges on the Manchester and Birmingham railway had been erected, according to the principles described, with perfect success, and with considerable saving in brickwork.

*Feb.* 10.—The discussion upon Mr. Barlow's paper "On the existence (practically) of a line of equal horizontal thrust in arches," was resumed. It was contended, that the theoretical propositions of Professor Moseley, in his work on engineering and architecture, although beautiful, were so abstruse as to be comparatively useless to the practical man. Mr. Barlow's object had been, on the contrary, to produce what might be termed an empirical rule, by which a line or curve of pressure could be laid down on the profile of an intended arch, by which it would be ascertained whether the structure contained the elements of stability, or whether, due allowance being made for the known qualities of certain materials, the arch would resist perfectly the pressure to be imposed upon it under all circumstances. It was evident that it must do this if the line of pressure, or the line of equal thrust, being traced, fell at each joint in such positions within the voussoirs as suited their form, dimensions, and quality of material. If the line passed at such points between the intrados and the extrados, as brought the surfaces of the voussoirs well into contact at full bearing, the figure described was practically correct, but if the line fell without either the intrados or the extrados, or in practice so near them as that the material should be unequal to support the insistent pressure, the voussoirs would either be crushed or would turn over on the points where the line fell; this had been previously insisted upon and demonstrated, by a model of a segmental arch, of which the surfaces of the voussoirs were curved. The arch assumed various forms, resulting from the mode of applying pressure, and the spot where it was applied; but in all cases the curve of pressure was shown to be traced by the points of contact of the curved surfaces of the voussoirs. This arch stood well, and on the pressure being removed, always returned to its original form, until such pressure was applied as brought the line so near the extremities of the voussoirs as to cause them to turn over on their points, and rupture ensued. Professor Moseley's proposition was very ably demonstrated, and it was argued that the formulæ given by him were practically applicable, and that it was more correct to take the one point given by his formulæ than to assume two points in order to find a third point, as directed in Mr. Barlow's method. On the other hand, it was contended, that for practical utility the assumed points were preferable, as they enabled the line of pressure or thrust to be determined at one operation, instead of working through the tentative processes requisite in the application of Professor Moseley's formulæ; and in this respect, Mr. Barlow's rule was preferable for the practical engineer. An arch should be viewed not as an assemblage of particles, but as a homogeneous and elastic mass, the pressure upon which extended in a greater or less degree over the whole surface: therefore, that which Mr. Barlow had designated the line of equal thrust might more properly be termed the line of neutral axis. It was argued also, that as an arch was defined to be "a system of bodies in contact, reposing ultimately upon the resisting surfaces called its abutments," an arch built of brick and cement might be considered as a curved girder, the abutments of the former acting as the tie rods of the latter. This was met by supposing the arch reversed, the apex being downwards, when evidently fractures must ensue. The principle of tension inherent in trussed girders did not at all exist in arches, wherein the forces were pressure and resistance. The practical consideration for arches was to adapt the form to the object for which it was intended. Thus, for a flat roadway, a very different form of arch must be used to that for a curved roadway, as in the one case the weight was not distributed over the arch as in the other case, and the point of rupture would be in a very different position; at the crown in one case, and at the haunches in the other.

*February*, 17th.—A paper was read "On water for locomotive engines and its chemical analysis," by William West, Assoc. Inst. C. E. The author commented severely on the want of precaution manifested in the choice of the watering stations on railways, where previous analysis of the quality of the water would have avoided considerable expenditure in subsequently procuring fit kinds of water and prevented great destruction of the boilers, and inconvenience from priming, which was induced by certain substances being held in solution or in suspension. He stated the principal components of earthy deposits were carbonate and sulphate of lime, which are bad conductors of heat, and when deposited upon a metallic plate or tube, which should be in contact with the water, the caloric traversed slowly, diminishing the evaporating power of the fuel in proportion to the accumulation of deposit, and rapidly oxidating the metal. The various substances present in spring or river water, such as soda, lime, magnesia, as bases, and sulphuric acid, carbonic acid, and chlorine, which represents hydrochloric or muriatic. Iron and organic matters were then reviewed, and the discrepancies in the results of analysis by different chemists were treated of, and it was shown that although there were apparent differences among chemists, they were not in reality so great as existed among engineers in their department.

In examining the tendency of different compounds to deposit, it was shown, that sulphate of lime was more disposed than the carbonate to attach itself to the plates: that a mixture of the sulphate caused a harder deposit than the carbonate alone, and therefore waters containing much sulphate should be avoided. Although what is generally termed 'hard' water, may be considered inferior to 'soft' water, yet in the question of deposit, hardness and softness were only vague terms, and could not be accepted as positive rules,—inasmuch as muriate of lime, which imparted great hardness to water, and therefore rendered it unfit for domestic purposes, was a very soluble salt, and therefore did not form any detrimental deposit. The author could only recommend, as a precaution against incrustation, the selection of water which was found to contain soluble salts,—or in situations where bad water could alone be obtained, that the boiler should be frequently blown through in order to get rid of the saturated water, before the crust had time to be deposited. The introduction of substances such as potatoes, leather, shavings, &c. into the boiler, in order to prevent incrustation by enveloping the earthy particles in a slimy coating, being inapplicable to locomotives because of the tendency to induce priming. The paper noticed slightly, the various patents for preventing adhesion in boilers, and in the appendix gave the analysis of many kinds of water which had been submitted to the author professionally for his opinion. In the discussion which ensued, Mr. Gooch spoke of the importance of the subject to railway and steam-boat companies, and stated, that his attention had been called to a process invented by Dr. Ritterbandt for preventing incrustation in boilers. That process consisted simply in the addition of a small quantity of muriate of ammonia to the water in the boiler. It had been found that this process not only effected the object proposed, but that it disintegrated and removed the incrustation already formed. In all the locomotives in which it had been used, the steam was much more readily generated, so that the blast pipes of several engines had been enlarged without diminishing this facility. There was, therefore, no doubt of a great saving of fuel being effected by the process, the expense of which was stated to be about three pence per hundred miles run of a locomotive engine. In sea-going steamers, the success of the experiment had not been less remarkable. In all these cases the water had been tested by practical chemists, without the slightest trace of iron or copper being detected, shewing that there was no injurious effect upon the metal of the boiler.

Dr. Ritterbandt stated, that carbonate of lime was the only substance which formed a solid incrustation; the other substances being merely mixed with, and cemented by the carbonate. The muriate of ammonia acted as a perfect solvent on the carbonate of lime, converting it into the soluble muriate, without acting upon the boiler. He then exhibited the action of the muriate of ammonia on calcareous water to the president and members.

## ART X.—REPORTS.

### ABSTRACT OF EVIDENCE BEFORE SELECT COMMITTEE ON ATMOSPHERIC RAILWAYS.

*Robinson, Rev. Thomas Romney*, D. D. Was originally sceptical as to the success of the atmospheric system; but after assisting in experiments at Wormwood Scrubbs has become an advocate for it. Has since examined the Dalkey line; from its excessive curves, is not a good example of the atmospheric principle. The distance of the engine from the tube is also a great disadvantage on that line. The leakages of the air-pump and of the connecting-tube are much greater than they need be in ordinary cases. The peculiar advantages of the atmospheric system can only be developed on a long line where the maximum velocity can be attained. The test applied by Mr. Stephenson is fallacious, by which he inferred from the state of the barometer that the maximum speed had been attained on the Dalkey line.

The atmospheric system will give the greatest advantages to the public. In point of safety it is scarcely possible to compare the atmospheric system with the locomotive; collisions are impossible, and all the dangers caused by the engine are removed. Various causes contribute to a greater certainty and regularity of the trains on the atmospheric principle. Very frequent trains also can be dispatched, and if required a very heavy train may be divided. A locomotive engine labours under various disadvantages in regard to power; there is much wear and tear, and necessity for certain peculiarities of construction which affect its power. Great deduction is to be made on account of its own weight which has to be moved. Less deflexion would take place on the rails of an atmospheric line, even if they were considerably lighter; a 50lb. rail would be much stronger than a 70lb. rail on a locomotive line; the effect of curves is to diminish the velocity; the resistance of the air to a train propelled upon the atmospheric principle is less. Dr. Lardner's views of the resistance of the air are erroneous; the amount, as estimated by him, includes also the resistance arising from concussions and compression of the rail and curvatures; but he assigns all these influences to the air. Resistance is offered by the compression of the rarefied warm air in the air-pump, previous to its expulsion into the atmosphere; this might be obviated.

Many of the existing causes of leakage could be prevented on better constructed lines. The leakage is found to be in proportion to the length of the tube, and not to vary with the power at which it is worked. The increasing pressure of the atmosphere at a high vacuum closes the valve more firmly, and prevents additional leakage. So little does he apprehend leakage on a well-constructed line, that he recommended one section of tube for the whole distance of 7 miles, from Dublin to Dalkey, to be worked by one engine. It is more prudent, perhaps, to begin with sections of three miles, but the alternate engine at six miles could do the work. The friction of the engine and its gear is very small. Mr. Hallet estimated the friction of the piston-carriage, and lifting up and sealing the valve, at 35lbs. only. Deductions are to be made from the power of the engine, first, on account of the force required to draw the air through the pipe, and secondly, for the friction of all the valve apparatus. The tractive power of the locomotive engine decreases very rapidly with an increase of speed; the decrease of power with increased speed is much less on an atmospheric line, and can be remedied; by a simple method such loss of tractive power can be overcome on an atmospheric line, by constantly rarefying the air in front of the train.

The extraordinary speed of the piston-carriage on the Dalkey line, detached from the train, Mr. Elrington stated to be at an average of 84 miles an hour. On a long line of 200 or 300 miles, one or two night-trains might be sent each day with letters, at the rate of 100 miles an hour. If the leakage could be prevented there would be no loss of power in a section of six miles, but then time would be expended in procuring a vacuum. In any system of traction curves should be avoided as much as possible, as they cause a loss of power, discomfort, and some danger at a high speed. The gradients on the Dalkey line, in spite of the severe curves, have not prevented a very satisfactory rate of speed. The curves are too sharp for the durability of the rail. There is not much wear upon the piston, which has a good deal of play. The shaft of the carriage is not much worn. The irregularity of the engine, arising from the expansive principle, could be corrected by working two together. The fracture of a carriage-axle is an accident liable to both systems, and so is an obstacle on the line; an atmospheric train going at a very high speed can be stopped in a distance of 140 or 150 feet; a locomotive engine could not be stopped in nearly that distance.

*Samuda, Joseph D'Aguilar.* Is patentee, jointly with Mr. Clegg, of the atmospheric railway. The portion of the line from the Dartmouth Arms to Croydon is to be worked by atmospheric power; that between the Dartmouth Arms and London, by locomotive engines; thus both systems will be tried together; mode of effecting the transference from one power to the other. Upon the London and Epsom the diameter of the tube is 15 inches. Mr. Samuda, last Session, estimated the tube at 4,000*l.* a mile; it can be supplied at about 3,800*l.* An atmospheric line is proposed from Dalkey to Bray, in continuation of the Kingstown and Dalkey Railway.

The atmospheric system will obtain a greater speed with more security and at a less cost than locomotive power; collisions are impossible; safety in passing curves; its superiority in ascending steep gradients; while a locomotive engine labours in that respect under disadvantages. By the atmospheric system the power can be adjusted according to the nature of the gradients. On the South Devon line the tubes vary in size, and the engines in power, according to the nature of the country. Means of varying the power of the engine and the speed of the train by working the tube to a higher or lower degree of exhaustion. The gradients make no difference in regard to speed, but only in regard to the power necessary to draw the load. The amount of power is always used which is necessary for the work. The power can be adjusted to the load by producing a greater or less vacuum, and consequently a greater or less pressure upon every square inch of the piston. The engines must be capable of working for the greatest pressure, which is accomplished by their working expansively, a means of great economy.

Much greater punctuality can be secured by the atmospheric system, as it depends upon the force applied and not to the state of the rails. Some trains are to run throughout, and others to stop at the stations. All trains would be carried at the same velocity, because the power would be adjusted to the load. There will be no large luggage trains, but they will be subdivided so as to maintain nearly a uniform weight and speed for every train. It is the direct interest of the owners of an atmospheric line to run frequent trains, as nearly all the expenses are the same whether they do so or not. Wear and tear of stationary engines is slight. There will be very little use for express trains. On the Croydon line there are a double set of engines, so that one engine may perform the exhaustion before another train can arrive. The same effect is proposed to be produced on the South Devon line by a tank of water, which on being emptied leaves a rarefied atmosphere.

One of the great advantages of the atmospheric system is the power of husbanding the power and adapting it to the loads. In some cases a water power could be used instead of an engine. Trains meeting at a passing place would be detained about four minutes. There will be double sets of engines, which can be brought to bear upon the trains at pleasure; on the South Devon line reservoirs may do the work of engines. The construction of a single atmospheric line would cost less than a double locomotive line. The height of the arches might be reduced, as there would be no engine-funnel to pass under them. Immense saving in earthwork, on account of the power of ascending steep inclines. A single line is amply sufficient for any traffic that can reasonably be anticipated. On the London and Birmingham line about 2,000 tons are carried daily; on a single atmospheric line over the same ground, 7,900 tons could be carried. The speed, excluding stoppages, would be 48 miles an hour; including stoppages, 39. It is proposed to have an expansive piston, on the South Devon line, to accommodate itself to the varied size of the tubes. The wear of the rails is scarcely perceptible; it is much less than on the locomotive lines. Superiority of the atmospheric line in point of comfort; absence of coke dust; smoothness of motion. Irregularity of movement is produced by the alternate action of the pistons in a locomotive engine. The engine-houses on the Croydon line will have chimnies like gothic towers, and will consume their own smoke. If a train overshot the station. it would be brought back by a small capstan.

In the event of a fracture to the axle of a carriage it could be removed from the line in five minutes. If the connecting plate broke, the piston would proceed to the station without the carriages; another carriage could then be sent, and a vacuum again created. The rails and sleepers may be lighter than in the locomotive lines. Security in descending steep inclines at great speed; there is a valve in the piston moderating the speed if required. Experiments made in pulling up a train rapidly and within a short distance; it can be effected more readily than with a locomotive train.

The air-pump might be dispensed with, and water used as the medium through which the vacuum might be formed, one train conductor would be sufficient for each train. In the event of an increase of traffic it would always be practicable to add a stationary engine at each station to increase the power. The greater the traffic the greater the advantage of the atmospheric system.

*Stephenson, Robert*, Civil Engineer. He entered into an investigation of the atmospheric principle of traction on railroads, for the directors of the Chester and Holyhead Railway, and addressed a report to them on the subject; this report was made on the occasion of an application by the promoters of the atmospheric system to employ it upon that line as a suitable line for the purpose. The result of the decision of the directors upon this report was, that it was by no means an economical mode of propulsion, No peculiar economy would have been produced in the first construction. and it would be more expensive in working.

There are some circumstances under which the atmospheric rather than the locomotive principles might be adopted. If the Blackwall Railway traffic had been between Blackwall and London alone the atmospheric would have been an extremely advantageous mode of propulsion. But with the present number of stations it would be so inconvenient as to render it inapplicable. Looking at the transmission of power as an abstract question, the expense of working the two lines is pretty much the same.

There are different kinds of power available for railway purposes; the stationary engine with ropes applicable to flat or hilly countries; the locomotive system; and, thirdly, the atmospheric. Loss of power under these different systems, arises, in the first case, from the friction of the rope; in the locomotive, the weight of the engine when moving from a level, and the resistance of the air; and in the atmospheric, the leakage. It is difficult to compare these different losses of power. The longitudinal valve on the Dalkey line is a complete triumph of mechanism; some improvement might be made in the composition, but mechanically nothing can be more perfect.

No greater speed is likely to be attained as a general rule, upon the atmospheric than upon the locomotive system; and there are cases in which the locomotive would beat the atmospheric; this is particularly the case with heavy loads over steep gradients. Taking high velocities into account, good gradients are positively more essential upon the atmospheric than upon the locomotive principle: with regard to the economy of the production of power with equal speed and equal gradients, the locomotive principle has much the advantage of the atmospheric. In gradients exceeding 1 in 100 the locomotive power becomes extravagant. The question of gradients in laying down a line of railway is one of very great importance; if the gradients can be brought within 1 in 100, taking the original capital into account, the atmospheric principle becomes useless; the locomotive is even better than the atmospheric under these circumstances; this is assuming a double line of tubes and a double series of engines necessary.

Is not aware of any circumstances applicable to the atmospheric system and not applicable to the locomotive, renderiug it feasible to work trains upon a single atmospheric line that could not be worked upon a single locomotive line. The Yarmouth and Norwich Railway is so worked on the locomotive principle. Upon the most mature consideration, is perfectly satisfied that the working a line with a single pipe is physically impossible. He founds his objection to the atmospheric system from the power required to attain a higher vacuum increasing in a much greater ratio than the vacuum produced. At low vacuums, the power is applied very directly to the work to be done, and is very economically and usefully exerted. The power which is applied to the piston of the piston-carriage is very economically applied by the pump: the whole of the power must bear upon the piston-carriage.

The friction of the machinery is, upon the whole, not very material, The real loss of power is leakage; this increases in effect as the vacuum becomes greater, and is the great deduction to be compared with the loss of power under the locomotive system. In an ordinary train the power exerted to move the engine and tender bears a very large proportion to the power exerted to move the train with passengers. The loss of the effective tractive power on the atmospheric system arises entirely from leakage; as this arises from defective mechanical contrivances, it is possible, but not probable, that in the progress of improvements this loss may be materially diminished.

The leakage on the Dalkey line is confined to the valve and pump. In experiments on the Dalkey line, he found the smallest height of mercury in the gauge gave the greatest velocity; the maximum velocity was rather under 40 miles an hour, the height of the mercury about 15 or 16 inches. The leakage would not increase with an increase in the size of the piston-pipe. The leakage diminishes as the train passes along, as a less surface is exposed; the velocity becomes more irregular as the train approaches the end of the tube. As the vacuum increased, there was an increased loss of power and diminution of velocity.

The waste of power on the locomotive and on the atmospheric system is pretty much the same. The mere generation of power is cheaper in the atmospheric than in the other; though there is more economy in the means of raising power by a stationary engine, there is a greater deduction to be made in consequence of the unemployed intervals. Superior economy in the working of the Blackwall line arises from the frequency of the trains.

On the atmospheric system the leakage is the cause of the whole loss of power when the trains are in motion. There is also a loss of power in getting up the vacuum on the tube; on the Dalkey line this is almost entirely lost; this is a loss of the same kind as that of getting up the steam in the locomotive engines, but not to such an extent. There would be no more risk of accident upon a single atmospheric line than upon a double locomative line; there is risk attending the intersection of the lines, and great danger in using what are called fixed points in the crossings at the stations. The plan suggested by Mr. Brunel for crossings looks very well upon paper, but will not work well in practice, it is too complicated.

Immense delay would be caused by stoppages on a long atmospheric line running frequent trains with a single line of tube; a double set of engines would go far to meet the difficulty; a double line of tube would remove the objection altogether. Upon the atmospheric principle the speed is recovered more rapidly than upon the locomotive after stopping, if the vacuum be raised.

In cases where very great traffic is not anticipated, he has recommended single lines of railway upon lines of considerable length upon the locomotive system; as in the case of the Yarmouth and Norwich. On the Peterborough and Northampton there are 45 miles of single line, and from Blisworth to Northampton, five miles of double line. Much greater expense would be incurred in working this line upon the atmospheric principle; in making the calculation of the expense of adopting the atmospheric system upon this line, witness did not take a tube of any particular diameter; on a line of this description, and with the same amount of traffic, a tube of six or seven inches would be quite sufficient.

Mr. Samuda's estimate of 1,300*l.* a mile for workshops, tools, water tanks, and matters of this description, excessive. The whole cost of working the North Midland line as a locomotive line, is less than the bare interest of money had it been laid down upon the atmospheric principle. During the seven years that the London and Birmingham line had been open, and 10,000,000 of miles have been traversed, there have been but two accidents from the breaking of the axles of engines. There is no reason to suppose that the amount of accident would be diminished by the atmospheric system as far as regards the breaking of axles and carriages; the result would probably be the same supposing there be no engine. There is a return regularly made to the Post-office of the interruption of the mail trains on the Birmingham line, stating the causes of delay; the late arrivals on all railways have arisen more from wind than anything else.

At the sidings and points, carriages would be equally as liable to get off the rail on the atmospheric as on the locomotive lines, there is nothing more to hold them.

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### WROUGHT IRON TUNNEL BRIDGE OVER THE MENAI STRAITS.

Gentlemen,—In reporting to you the progress which has been made in the works, I beg to refer you to the statements of Mr. Ross and Mr. Forster, made from time to time, as regards those under contract. In addition, I need only state, that last week I examined them personally, and found the whole progressing in the most satisfactory manner. I will therefore proceed at once to lay before you the results of the experimental investigation which, with your sanction, I commenced some months ago in reference to the construction of the bridge over the Menai Straits. The object of this investigation, as you are aware, was to test the truth of the views I entertained respecting the employment of a large wrought-iron tube, instead of cast-iron arches, as we originally proposed; but which we were compelled to abandon, in consequence of the Admiralty refusing to allow the erection of such a structure, from the belief that it would injuriously interfere with the navigation of the Straits. In conducting this experimental investigation, I saw the importance of avoiding the influence of any preconceived views of my own, or at least to check them, by calling in the aid of other parties thoroughly conversant with such researches. For this purpose, I have availed myself of the assistance of Mr. Fairbairn and Mr. Hodgkinson; the former, so well known for his thorough practical knowledge in such matters, and the latter, distinguished as the first scientific authority in the strength of iron beams. These gentlemen have pursued the subject with deep interest, and, although they have not yet been able to bring the facts into a final and definite shape, they have each complied with my request, that they would communicate their views upon the results which have already been arrived at. I therefore append to this Report their observations just as I received them. They will, I am confident, prove satisfactory to you. I have throughout the experiments carefully studied the results as they developed themselves, and I am satisfied that the views I ventured to express twelve months ago were in the main correct, and that the adoption of a wrought-iron tube is the most efficient, as well as the most economical description of structure that can be devised for a railway bridge across the Menai Straits. In the course of the experiments, it is true, some unexpected and anomalous results presented themselves; but none of them tended in my mind to show that the tubular form was not the very best for obtaining a rigid roadway for a railroad over a span of 450 feet, which is the absolute requirement for a bridge over the Menai Straits.

The first series of experiments was made with plain circular tubes, the second with elliptical, and the third with rectangular. In the whole of these, this remarkable and unexpected fact was brought to light, viz., that in such tubes the power of wrought-iron to resist compression was much less than its power to resist tension, being exactly the reverse of that which holds with cast-iron; for example, in cast-iron beams for sustaining weight, the proper form is to dispose of the greater portion of the material at the bottom side of the beam, whereas with wrought-iron, these experiments demonstrate beyond any doubt that the greater portion of the material should be distributed on the upper side of the beam. We have arrived, therefore, at a fact having a most important bearing upon the construction of the tube; viz., that rigidity and strength are best obtained by throwing the greatest thickness of material into the upper side.

Another instructive lesson which the experiments have disclosed is, that the rectangular tube is by far the strongest, that the circular and elliptical should be discarded altogether. This result is extremely fortunate, as it greatly facilitates the mechanical arrangements for not merely the construction, but the permanent maintenance of the bridge. We may now, therefore, consider that two essential points have been finally determined: the form of the tube, and the distribution of the material.

The only important question now remaining to be solved, is the absolute ultimate strength of a tube of any given dimensions. This is of course approximately solved by the experiments already completed; but Mr. Hodgkinson very properly states, that others, with tubes of more varied dimensions, should be continued in order to clear up some anomalies which still exist. The formula, as at present brought out by Mr. Hodgkinson, gives the strength of a rectangular tube of the dimensions I proposed, viz. 450 feet long, 15 feet wide, by 30 feet high, (assuming the plates to be one inch thick,) equal to 1,000 tons applied in the centre, including the weight of the tube itself, but deducting the latter, equal to 747 tons in the centre, or double this, supposing the weight to be uniformally distributed over the whole 450 feet. This amount of strength, although sufficient to carry any weight that can in practice be placed upon the bridge, is not sufficiently in excess for practical purposes. It is on this ground, therefore, I have requested Mr. Hodgkinson to devise a few more experiments in the shape best calculated to free the formula from all ambiguity. In the mean time, however, as I consider the main question settled, I am proceeding with the designs and working plans for the whole of the masonry, which I expect to have the pleasure of submitting to you in a fortnight from this time.

You will observe in Mr. Fairbairn's remarks, that he contemplates the feasibility of stripping the tube entirely of all the chains that may be required in the erection of the bridge; whereas on the other hand, Mr. Hodgkinson thinks the chains will be an essential, or at all events, a useful auxiliary, to give the tube the requisite strength and rigidity. This, however, will be determined by the proposed additional experiments, and does not interfere with the construction of the masonry, which is designed so as to admit of the tube, with or without the chains. The application of chains as an auxiliary has occupied much of my attention, and I am satisfied that the ordinary mode of applying them to suspension bridges is wholly inadmissible in the present instance; if, therefore, it be hereafter found necessary or desirable to employ them in conjunction with the tube, another mode of applying them must be devised, as it is absolutely essential to attach them in such a manner as to preclude the possibility of the smallest oscillation. In the accomplishment of this I see no difficulty whatever; and the designs have been arranged accordingly, in order to avoid any further delay. The injurious consequences attending the ordinary mode of employing chains in suspension bridges was brought under my observation in a very striking manner on the Stockton and Darlington Railway, where I was called upon to erect a new bridge for carrying the railway across the rives Tees, in lieu of an ordinary iron bridge, which had proved an entire failure.

Immediately on opening the suspension bridge for railway traffic, the undulations into which the roadway was thrown by the inevitable unequal distribution of the weight of the train upon it, were such as to threaten the instant downfall of the whole structure. These dangerous undulations were most materially aggravated by the chain itself, for this obvious reason, that the platform or roadway, which was constructed with ordinary trussing for the purpose of rendering it comparatively rigid, was suspended to the chain, which was perfectly flexible, all the parts of the latter being in equilibrium. The structure was, therefore, composed of two parts, the stability of the one being totally incompatible with that of the other: for example, the moment an unequal distribution of weight upon the roadway took place by the passage of a train, the curve of the chain altered, one portion descending at the point immediately above the greatest weight, and consequently causing some other portion to ascend in a corresponding degree, which necessarily raised the platform with it, and augmented the undulation. So seriously was this defect found to operate, that immediate steps were taken to support the platform underneath by ordinary trussing; in short, by the erection of a complete wooden bridge, which took off a large proportion of the strain upon the chains. If the chains had been wholly removed, the substructure would have been more effective, but as they were allowed to remain, with the view of assisting, they still partake of these changes in the form of the curve, consequent upon the unequal distribution of the weight, and eventually destroyed all the connections of the wooden framework underneath the platform, and even loosened and suspended many of the piles upon which the framework rested, and to which it was attached.

The study of these and other circumstances connected with the Stockton Bridge lead me to reject all idea of deriving aid from chains employed in the ordinary manner. I have therefore turned my attention to other modes of employing them in conjunction with the wrought iron tube (as suggested by Mr. Hodgkinson), if such should be found necessary upon further investigation. As I have already stated, in this I perceive no difficulty whatever; indeed, there is no other construction which has occurred to me which presents such facilities as the rectangular tube for such a combination. Having, I trust, clearly explained my views in reference to this important work, I have only to add, that in two months I expect every arrangement will be completed for commencing the masonry, which will be conducted with the utmost activity and vigour. I can scarcely venture to say, until after these arrangements are finally completed, at what period we may calculate upon the completion of this bridge, but I cannot recommend you to calculate upon the whole being accomplished in less than two years and a half.

Robert Stephenson.

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## Art. XI.—THINGS OF THE DAY.

### FINE ARTS.

*The New Houses of Parliament.*—The fifth report of the Commissioners of Fine Arts has now been issued. It appears from the report that six arched compartments in the House of Lords are to be decorated with fresco paintings, and that one of the fresco paintings should be completed before the others are commenced, by which means an opportunity would be afforded of judging of the finished work. The competition in oil painting has been postponed till June, 1847. In the appendix is a report from the committee, consisting of Lord Mahon, Mr. Hallam, Mr. Hawes, jun., Mr. Macaulay, Sir R. H. Inglis, Mr. Rogers, and Mr. Wyse, respecting the subjects suitable for stained glass windows in the House of Lords. In the appendix is a report from Mr. Eastlake, the secretary, on the styles and methods of painting suited to the decoration of public buildings.

*New Equestrian Statue of Buonaparte.*—M. the Baron de Marochetti has been intrusted with the execution of an equestrian statue of Napoleon on the esplanade of the Invalides in Paris. Before commencing his work, the Baron wished to make some trials by means of pasteboard specimens; and two new ones have just been made. The first has been placed at the point where the grand *chaussée* of the esplanade meets the Rue St. Dominique St. Jermain. The equestrian statue is represented under the two principal aspects of full-face and profile. The pedestal of gray Corsican granite, rests upon a sub-basement of three steps. The Emperor is represented in a Roman costume, his head encircled with laurels, a sceptre in his right hand, and a short cloak over his shoulders; a tiger's skin replaces the saddle. The horse rests on two legs. The statue is to be cast in bronze. The second specimen is at the point of intersection of the same grand *chaussée* with the Rue de l'Université. This statue is also represented under two different aspects—a full-face and a profile. The pedestal rests on the sub-basement of red granite; it is of bronze, adorned with eagles, cannons, and trophies; its form is less elongated. The horse reposes on his four legs; his head is inclined. The emperor is again represented in a Roman costume, crowned with laurels, his right hand holding a sceptre, and his left the bridle. The body of the horse, and even his legs and feet, are covered with an ample drapery. This statue is also to be cast in bronze.

*Royal Academy of Brussels.*—The following is a list of the names elected by the Fine Art Section of the Royal Academy of Brussels, as Foreign Associates, on the first organization of the latter as a Belgian Institute. In the division of Painting,—Landseer, of London; Horace Vernet, Ary Scheffer, and Paul Delaroche, at Paris; Cornelius, at Berlin; and Kaulbach, at Munich. In Sculpture,—Macdonald, in London; Schadow and Rauch, at Berlin; Pradier, Rude and Ramey, at Paris; Donaldson, of London; Fountaine, at Paris; Von Klenze, at Munich. In Engraving,—Wyon, of London; the Baron Desnoyers, MM. Forster and Barre the elder, in Paris. In Music,—Rossini at Bologna; Meyerbeer, at Berlin; Auber, and Spontini, in Paris; Daussogne-Mehul, director of the Conservatory at Liege. For the departments of the Sciences and Letters, their relation to the Fine Arts,—Bock, at Brussels; Passavant and David at Frankfort.

*The Campbell Monument.*—Mr. Marshal, A.R.A., the sculptor appointed to execute the statue of Lord Clarendon for the new Houses of Parliament, is also engaged upon the monument to be erected to Thomas Campbell, in Poet's Corner, Westminster-Abbey. This monument will consist of a statue of the poet leaning upon a pedestal, on which is a figure of Hope in bas-relief. At the foot is a lyre with a wreath. Mr. Marshall has represented the bard in his robe as Lord Rector of Glasgow.

*China Service Medals.*—Mr. Wyon, the engraver to the Mint, has just completed the die for the medals to be distributed to the officers and men of both services who shared in the late war with China: and preparations are making to strike off the impressions to the number of 18,000. They are all to be in silver, no difference being made between the commissioned and the private. The medal exhibits a portrait of the Queen, with the words "Victoria Regina;" and on the reverse is a trophy, composed of naval and military weapons, resting under the shadow of a palm tree, which supports the armorial bearings of Great Britain.

*Duty on Foreign Patterns.*—Application having been made to the Lords Commissioners of the Treasury by an eminent firm interested in the importation of such articles complaining of the officers of the revenue having demanded the duty of 1*d.* each as single prints upon sundry patterns of embroidery and drawing imported into the port of London, the authorities have received a communication from Mr. Cardwell, one of the secretaries to the Treasury, stating that he has been commanded by their Lordships to convey to them their authority for allowing the importation to be admitted at the rated duty of 3*d.* per dozen, being the same rate as is chargeable on prints sewn or bound, and that this indulgence was to be extended to all similar importations of the article applicable to the same purpose.

*Summary.*—The grand staircase of Buckingham Palace has been decorated under the direction of Mr. Gruner, and is now completed after the manner of the Italian masters. On the ceiling, four fresco paintings on gold ground, representing morning, evening, noon, and night, have been executed by Mr. O. Townsend.—At Rome, the sculptors Tenerani and Tenioyne have been elected members of the Imperial Academy of Fine Arts at St. Petersburgh.—The restoration of the Portland Vase is now completed, and managed with such art that the closest scrutiny, it is said, is scarcely able to detect a blemish.—The hall of the Ancestors of Fouthinés, a monument of Egyptian archæology, upwards of 3,500 years old, has just been placed in the Royal Library in Paris. M. Pressé, a French traveller, in 1842, conceived the idea of transporting this interesting relic of antiquity to France, and having had the stones carefully removed, they were packed up in cases, and shipped on board a vessel. It now appears exactly as it stood at Karnak.—A bill is before the French Chambers for regulating the copyright in all works of art and design applied to manufactures.—The Liverpool corporation has agreed to give upwards of 80,000*l.* for the Newsham estate of 200 acres, contiguous to the Zoological Gardens, for a public park. The purchase of other ground, so as to surround these picturesque gardens, is talked of.—The King of Wirtemberg has rewarded Herr Zanth for the design and construction of the Casino, called the Wilhelma, by creating him a knight of the Royal Order of the Crown.—The Picture Gallery of Dresden, the depositary of the Madonna del Sisto of Raphael, and other incomparable works, is now likely to be replaced by a building more in accordance with the demands of our age. The cost is estimated at 350,000 thalers, about 37,000*l.*—At Amsterdam, the Dutch are about to erect a bronze statue of their illustrious countryman, Rembrandt, in front of the Museum.—Government of Bavaria has bought the collection of antiquities, in terra cotta, of the Swedish sculptor, Fogelberg—better known as the Chevalier Benedetto.—The repairs and decorations now in progress at the Liverpool town-hall will cost about 5,000*l.*—A vase has been dug up in Rome which shows in a singular manner the transition from Roman to Christian art. It is of black marble, about four feet high,—Acanthus leaves and Satyr heads.—Overbeck has nearly completed an oil painting, destined for his native city, Lubeck—the Sepulture of Jesus Christ.—M. Grass, a native of Strasburg, and for several years past attached to the works of restoration going on at the cathedral of that city, has been commissioned to execute a group of 'The Last Judgment,' to replace that formerly existing over the great gate.—The exquisite collection of terra-cotta figures, which had formerly belonged to the Swedish sculptor, Fogelberg, at Rome, has been purchased by the King of Bavaria.—The Rhenish papers mention a discovery, of very curious interest, that has been made in recently demolishing the ancient Church of Urbach, which dates from the earliest period of the middle age, and was tottering to its fall. Enclosed in the wall of the choir, which is four feet thick, has been found a marble coffin, nine feet four inches in length, and adorned with figures in relief, finely executed. The opening of this coffin was a difficult operation,—the joints having been covered with a cement which had acquired the hardness of the marble itself. It had, accordingly, to be broken into from the foot; and revealed an object which took the spectators by surprise—a body, clothed in the sacerdotal habit, fresh as that of a man who died but yesterday. The colour of the epidermis, firmness of the flesh, the hair, the nails, all were in the most perfect preservation. The flesh yields beneath the finger like soft wax; the limbs have kept their suppleness and flexibility; the teeth are entire, regular, and white as ivory; and the very eyes, but half closed by the eyelid, have preserved a portion of their brightness. The dead man wears a cassock of pale blue silk, inwoven with threads of pure gold; and a linen gown, extremely fine, and trimmed with lace. These garments, worn so many hundred years, seem quite new. Round the hands, clasped on the breast, is twined a rosary of white pearls, strung on thread of gold—to which is attached a small box, in form of a medallion, made of a metal whose composition is unknown. This medallion contains, on one of its faces, the following inscription, in characters which suggest the date of the eleventh century:—*Otto Imperator Parocho Irbicchiano sculptori excellentissimo*;—"The Emperor Otho to the Curate of Urbach, a most excellent sculptor." On the reverse is the figure of the Good Shepherd. Being opened, the box was found to inclose a folded parchment, containing writing in letters of gold and ultramarine. The ancient text is difficult to decipher; but records that the priest in question, one of the greatest artists of his age, is the author of the wondrous sculptures, representing Scripture-subjects, on the principal front of the high altar; and that the sculptured pulpit, which was the great ornament of the church, is from his chisel. The artist-curate must have been, also, in matters unspiritual, one of the greatest men of his day. The body measures, from the crown of his head to the sole of the foot, seven feet eleven inches, Rhenish measure. The feet, nearly covered by the cassock, rest on a folio volume in parchment, whose first leaf displays the title:—*Chronicon Sœculi XI.*—A Roman Mosaic Floor was discovered last year at Cologne, near St. Peter's chapel. In the middle of the square floor is enclosed the bust of the cynic, Diogenes, in a hexagon, together with his name in Greek characters—around this are the portraits of six other sages of antiquity, including Socrates and Sophocles. The whole floor is in a good state of preservation.

CONSTRUCTION.

*Dinting Vale Viaduct.*—A Description of the Dinting Vale Viaduct on the line of the Sheffield and Manchester Railway has been read before the Institution of Civil Engineers, by Mr. A. J. Jee. This viaduct consists of sixteen arches, five of which are of timber, and eleven of brick. The whole of the large piers, wings, outside spandrils and parapets are built of stone from the quarries in the neighbourhood. The five large arches which are each of 125 feet span, and 25 feet versed sine, are built of Memel timber; the main ribs of these arches are composed of planking three inches thick; bent and laid longitudinally and fastened together with oak trenails, and firmly stayed by means of wrought iron tie-rods. The smaller semicircular arches, situated at each end of the viaduct, are built of brick with stone quoins. They are of 50 feet in the span and 3 feet in thickness, and are built in a curve of 40 chains radius, the piers being wedge-shaped to suit the curve, leaving the faces parallel with each other. The entire cost of the viaduct was 35,250*l.* 6*s.* 5*d.* Its total length 484 yards, and its greatest height about 125 feet above the water-course. It was commenced early in 1843, and was opened on the 8th of August, 2844. The average cost of construction was calculated to be 2*l.* 14*s.* per superficial yard, and 6*s.* 9*d.* per cubic yard, the viaduct being 8 yards wide.

*Moving Houses in America.*—It is astonishing that the economical system of shifting houses, which is often practised among the Americans, has not been introduced into this country. There, instead of throwing down the lower part of a house in order to convert it into a shop, they raise the whole house and put the shop underneath. By this means, too, a house which had not been originally very substantial, might be raised with safety one or more stories, although it would be dangerous to attempt to superpose them.

*Method of preparing and fixing Railway Sleepers.*—On the Dublin and Drogheda Railway, the sleepers are half baulks, 12 inches by 6 inches at the junction of the rails, and intermediately half trees of Larch with the bark on, not less than 8 inches by 4 inches, are placed with the round side upwards, at an average distance of 2¾ feet 6 inches apart. These sleepers are prepared for bearing the rails, by fixing twelve at a time on a sliding-table, similar to that of a planing machine: they are moved forward by steam power, beneath two circular cutters set at the given distance of the gauge apart, and revolving very rapidly, and which pass through the whole series of sleepers, cutting at a given inclination the seats for the rails. A slight stoppage of the table takes place as each sleeper is cut, in order to afford time for four drills to descend simultaneously, and to pierce the holes for the pins or trenails for holding down the rails. An engine of six-horse power suffices for working two of these machines, by which one thousand sleepers can be finished complete in twenty-four hours at an expense of about one penny each, instead of two-pence halfpenny each, which they formerly cost by manual labour. The sleepers thus prepared are used transversely beneath rails of the bridge, form of which the sides are slightly pinched inwards in finishing, so as to form a dovetail with a joint-plate with a raised rib, which is laid at each junction and which by using a screw pin and plate at one end, and a collar-headed, pin at the other, holds the rail very fast, preventing lateral and vertical contraction, but permitting longitudinal action in expanse and contraction. These rails weigh 83 lbs. per yard. The total cost per mile of the double line, including rails, sleepers, pins, spikes, joint-chairs, &c. laid complete, is stated at 3470*l.* 2*s.* 8*d.*, when the rails cost 7*l.* 5*s.* per ton.

*Diving Bell for laying Stones under water.*—At the Institution of Civil Engineers, Mr. W. Vanderkeite has described a very useful arrangement of machinery for working the Diving Bell used in setting the masonry, at a depth of about 8 feet below the level of extraordinary spring tides, in the extension of the Pier at Kilrush in the river Shannon, under the direction of Mr. T. Rhodes, the chief engineer of the Shannon commissioners. Upon a series of piles and longitudinal timbers a railway was laid, upon which two travelling platforms were constructed, with winches, &c. One of them brought the stone nearly over its intended position and lowered it into the sea; the other then brought the diving bell over it, and by means of a chain and purchase, the stone was lifted, and placed properly in its place by the men in the bell. This work was continued through all seasons, and with the utmost regularity, and the work so constructed was as solid as if built on dry land.

*Paris Observatory.*—They are at present constructing on the top of the Royal Observatory in Paris, a cabinet, the walls of which, as well as the ceiling, are of crystal. In this chamber, M. Arago will watch the march of the stars, planets, and comets, by the assistance of a monster telescope, which is now being made.

*Artesian Well.*—It is in contemplation to enlarge the artesian well which supplies the pump in Berkeley-square for the use of the neighbourhood; to erect a cistern and steam-engine behind some of the houses in the vicinity, and employ the water to supply a fountain in the centre of the plantation, as well as all the houses in the square.

*Summary.*—At the works for the auxiliary port La Joilette, at Marseilles, blocks of concrete, 13 yards cubic measure in size, have been sunk for the foundation.—The first stone of Galway Queen's College will be laid towards the close of next month. The edifice will be in the gothic style, after the design of Mr. Kean.—It is stated that there are nearly 100 building societies in Liverpool, and that their capital amounts to 240,000*l.*—Mr. Vicat, chief engineer and director of roads and bridges, who had received from the French parliament a national recompense for his investigations on lime and mortar, has been promoted by the king to the rank of a commander of the royal order of the Legion of Honour.—A quarry of fine marble has been found on the Duke of Montrose's land at Aberfoyle, adjacent to the Forth and Clyde Railway.—A model lodging-house for the poor has been opened at No. 27, King-street, Drury-lane. The house has undergone a thorough repair, and is fitted up to accommodate forty single men or boys. The terms are fourpence per night, which include the use of a common kitchen, well supplied with every article requisite to prepare a meal.—A spacious school, in the early English style, and capable of accommodating 800 children, has been erected in Liverpool, at the extreme end of Grafton street, Toxteth-park.—Alarm has been excited by the discovery that one of the towers of the Abbey of St. Denis is in danger of falling in; and it appears that it will have to be rebuilt.—The town council of Marseilles have sanctioned a contract for exhausting and laying dry the great pond of Pourra by means of powerful engines.—A correspondent of the Times says, that many of the newly-constructed buildings at Hamburgh have given way under the influence of heavy rains, and that some of them require to be secured by strong wooden props: the examination ordered by the senate is said to have produced some very disagreeable discoveries.—The streets of Lisbon are all to be macadamised; and a new aqueduct for the capital has been projected.—The masons employed in building the bridges and culverts on the Newcastle and Berwick Railway, near Alnwick, have struck for an advance of wages. They have made a proposal to their employer to resume work on receiving the same wages as are paid on the southern part of the line—viz., 26*s.* per week.—A corn and flour warehouse, seven stories high, situate in Moor-street, Liverpool, fell with a tremendous crash. There were at the time of the calamity 11,000 sacks of flour, a large quantity of the same materials in barrels, besides much cotton and grain in the building.—The preparatory works for the Appenine Railway are progressing fast. On the side of the mountains, it has been ascertained that the greatest rise will not exceed 3 per cent, a similar slope to the line from Gloucester to Birmingham, and therefore workable by engines. The tunnel, which at first was expected to be of a great length, will, according to present measurement, not be more than one mile long, like that from Sienna to Leopolda.—A patent has just been obtained by Mr. H. H. Russell, for a new mode of arranging the curves in suspension bridges, by means of which the vibration and oscillation of those structures are entirely neutralized, and thereby rendered available for railway purposes. The novelty of the invention consists in the arrangement of the chains.—The Suspension Bridge joining St. Gillies to Croix-de-Vie (Vendée) constructed about ten years back, has fallen down under the weight of a heavy waggon passing over it.—It is said that a railway will be brought before Parliament thirty-seven miles long and "all tunnel."—The ancient church of Colemore, near Alton, Hants, has lately undergone complete restoration. The roof has been stripped and repaired; the timbers freed from whitewash, stained and varnished; an ancient transept, long desecrated, has been restored.—The Martello towers of Jersey are undergoing repair and improvement. They are to be rendered habitable, and the loop-holes, which throughout the island are too wide, are to be narrowed.—It is in contemplation to erect a new police-station at Swindon, to consist of entrance hall, rooms for superintendent, &c., with a justice room above, and two wings containing cells for prisoners. The estimate for the building, excluding the site, is 500*l.*—The tunnel through Stoke Hill, near Ipswich, on the Eastern Union Railway is proceeding steadily. Its length when completed will be about 400 yards. On a greater portion of the line, from Belstead to Brantham, permanent rails are laid down, and the sides of the embankments and slopes for some distance are in a finished state.—A new church is about to be erected at Clandown, near Bath. The Prince of Wales, as Duke of Cornwall, has subscribed 100*l.* towards the expences.—Water-works upon an extensive scale are about to be constructed at Great Yarmouth.—It is expected that the north wing of the University College Hospital will be commenced during the approaching spring. It is calculated to cost 4,000*l.* the whole of which with the exception of about 600*l.* is subscribed for.—The Dundee water-works are being prosecuted with energy The large reservoir and clean-water bason at Craigton Muir, on the Panmure estate are considerably advanced; and, by the liberality of Lord Panmure, every facility will be given in execution of the work. The space to be covered by the reservoir will extend to about ninety or one hundred acres.—The new steam basin at Portsmouth is in a forward state, a large portion of it being nearly completed. The walls are of the most substantial formation, their entire facing being of granite blocks.—A new church is about to be erected at Woolwich, after a design by Mr. Gwilt. It is to be constructed in the Byzantine style of architecture. and capable of accommodating 1,000 persons; the cost of its erection, including every incidental expenditure, will not exceed 7,000*l.*

### RAILWAYS.

*Inconveniences of Railway Investment.*—Mr. James Morrison, M.P. for Inverness, has published a pamphlet on "railway legislation," to which, much attention is at present directed. The foundatiou of his argument is the suspicion that the railways now in course of construction, and those which are likely to be voted during the present session, will require a larger annual outlay than the country can afford. The present expenditure is at the rate of about 24,000,000*l.* per annum; and this is expected to be doubled or trebled by the projects to receive Parliamentary sanction this session. Considering that there are a variety of other demands for money having an equal importance with that made on account of railways, the drain on the monetary resources of the country threatens to raise the value of money, and to occasion much distress. The question, therefore, is, how the excessive multiplication of railway projects is to be prevented without a restriction of private enterprise, or the reservation to the Government of the initiative in planning the lines, as in France. The remedy according to Mr. Morrison, is to be found in the establishment of a system of low fares by the Legislature. Low fares, though highly remunerative when a line connects populous districts, would operate as a powerful impediment against the construction of such railways as would not be likely to realize a sufficient traffic.

*Slip on the Great Western Railway.*—A slip has taken place on an embankment on the Great Western Railway near Chippenham station, occasioned as is supposed by protracted wet weather. The bank has fallen completely from the rail, and any train passing over it must have met with instant destruction, as nothing could have prevented its falling into the chasm. The extent of the damage is estimated at from 1000*l.* to 1,200*l.*, Every exertion to avoid further accident was immediately used by the servants of the company, and although compelled at this point to use a single line of rail, but little delay has been occasioned in the working of the trains. A slip of a less important kiud has occurred near Wotton Bassett.

*Reduction of Fares.*—The Grand Junction and Birmingham Company have just made a further reduction of fares. Between Liverpool and London the fares are reduced as follows:—Express and select trains, from 47s. to 45s.; first class, from 40s. to 37s.: second class, from 31s. to 27s. The fares between London and Chester, Lancaster and Preston, are reduced in the same proportion. Between Liverpool and Birmingham, the second class is reduced from 14s. to 13s. From London to Birmingham, the reductions are, by express and select trains, first class, from 27s. to 25s.; by mixed fast and select trains, first class, from 23s. to 20s.; by mixed fast and select trains, second class, from 17s. to 14s.

*Statistics of Railways.*—The "Journal des Débats," contains an article upon the railroads in various countries, but more particularly those in France and Germany, from which it appears that the latter country, with a population of 60,000,000 and a superficies of 113,000,000 hectarcs, possesses 2,560 kilometres of railroad in actual operation, and 4,700 kilometres in course of formation; making a total of 7,260 kilometres. France, with a population of 35,000,000, and a superficies of 53,000,000 hectares, has 77 kilometres of railroads in full operation, 3,650 kilometres in course of formation, and 1,050 kilometres for the formation of which bills have been presented to the Chambers, and which are sure, in the course of six or eight months, to be in a forward state of construction, making a total of 5,475 kilometres, or 156 kilometres per 1,000,000 souls, and 101 kilometres per 1,000,000 hectares. Great Britain has, or will shortly have, 200 kilometres of railroad completed for every 1,000,000 souls, and 160 kilometres per 1,000,000 hectares. America has 730 kilometres per 1,000,000 souls, and 59 kilometres for every 1,000,000 hectares of its enormous superficies. Thus it appears that France is behind England and America, but before all other nations as regards railroads. The railroads in France cost upon an average, 300,000f. per kilometre. In England, in many instances, they cost as much as 800,000f. per kilometre; and in Germany, owing to the favourable nature of the ground, 200,000 and very frequently not more than 150,000f. In Germany more than three-fourths of the travellers take the last places, one-fifth the second, and only three in every 100 the first. This state of things denotes a country whose inhabitants, generally speaking, are not in very easy circumstances. In this respect, as in many others, France occupies a position between England and Germany. The speed on tbe German lines is not very great, which may be accounted for by their peculiar mode af construction, and which also proves that as yet time in that country is not very precious. With respect to the returns, it may be stated that the best lines iu England produce about 100,000f. or 120,000f. per kilometre; those in France little more than half that sum; and the German lines little more than half tbose of France.

*Railway Steamers.*—The Eastern Counties Railway Company purpose running steamers from Harwich. This port is nearer to Hamburg than London by 60 sea miles, and than Hull by 27 miles! It is nearer to the Helder, Amsterdam, &c., than Hull, by 50 miles, and than London by 60 miles; it is nearer to the Brielle and Rotterdam than Hull by 89 miles, and than London by 60 miles; and it is nearer than London to Flushing and Antwerp by 53 miles, and to Ostend by 46 miles.

*Summary.*—The Croydon Atmospheric Line is now workiug daily for ordinary traffic. Trains go up and down once every hour.—The engineers of unstable railway works appear to be summarily dealt with in Belgium. The following appears in the Belgian papers:—"Last night the gendarmes arrested M. R— the engineer of the railroad. It appears that the judicial authority is anxious to have the affair of Camptich brought before the Chamber. We have just been informed that MM. B— and S— sons, engineers, have been arrested, and other arrests are spoken of.—At a special meeting of the Severn Commissions, held during the month at Bristol, it was unanimously resolved to erect a new bridge at Upton, and to raise 30,000*l.* to defray the cost of the same. Mr. Williams handed in the plans of the proposed structure, which is a "bascule," or perpendicular drawbridge. Lord Hatherton remarked that at Amsterdam, and many other places on the continent, the same kind of bridge was in use, and had not been found to offer any obstruction to the navigation.—Several hundred labourers on the Lancaster and Carlisle railway, near Kendal, have struck for an advance of wages; they demand 4s. per day, and fortnightly payments.—Mr. W. Constable, of Brighton, has suggested the construction of an instrument to be attached to a railway carriage that shall describe on a chart line, indicating the various speed of a journey, to act as a check on reckless driving.—Letters from Prague announce that the intercourse between that city and Vienna by railroad is broken up, the floods having carried away a bridge.—Much snow has fallen on the Hartz Mountains, and in Clausthal a low-lying road had beeu so completely filled with snow as to cover over the roofs of several houses situated upon it, the inhabitants of which had to work their way to upper air through the roofs of their dwellings.—The steamers at Buffalo, in the United States, go twice a day to Chicago, 1,050 miles up the Lakes, for 1*l.* 12*s.*; and give three good and substantial meals a day, and an excellent roomy cabin to each to sleep in, besides the use of a splendid saloon and promenade. This is less than one halfpenny per mile, board and lodging included.—The deposits for Ireland are found to be just 940,000*l.*, and those for Scotland 2,500,000*l.*, which, with the 11,492,000*l.* for England, make the total closely to approximate to 15,000,000*l.* The works between Croydon and Epsom are going on with activity. At Beddington some inconveniences have been experienced by the number of caves which the excavations brought to light.—The viaduct at Cockwood, 11 miles from Exeter on the South Devon, has been ignited by a pot of boiling pitch, and much damaged. The fire was eventually put out.—The projected New Bridge across the Medway, at Rochester, was intended to serve both for foot passengers and carriages, and likewise to have a tunnelled passage for South-Eastern branch railway. The citizens of Rochester are much alarmed at the Admiralty's order that the bridge shall be a swing bridge, and are remonstrating accordingly.—The animosities between Irish and English labourers on railways are spreading. The labourers on the Kendal aud Windermere, following the example of those on the Lancaster and Carlisle at Penrith, have mustered, to the number of about 120, near Birklands, armed with weapons of various descriptions, and, after using menacing language, compelled the Irish to cease work.—The Prussian ship Lachs, arrived in the West India Docks from Dantzic, has brought the large number of nearly 13,000 sleepers.—Progress is being made through the hill, near Reading, on the Bath road; 500 men have been set to work near Theale, 5 miles from Reading, and a considerable numher near Thatcham, five miles from Newbury.—The De Warrenne stone coffins recently discovered at Lewis, in the excavations for the Hastings railway, were brought to town on the Brighton line, and exhibited at a meeting of the Archæological Institute.—According to a table published by the "Official Gazette of Prussia," 12 railways have already been opened, forming together more than 500 English miles. These 12 lines carried in 1844, 3,940,904 passengers of various classes, and 7,845,086 quintals of merchandise. The Prussian system of railways is so combined as to make Berlin the centre of all the principal lines. In Prussia the new lines conceded or under construction, 20 in number, will cover an extent of 1,200 English miles. The Prussian railways executed and in course of construction will have absorbed a capital of about 20,000,000*l.*—The tunnel through Rose-hill, near Brighton, is nearly finished. An embankment has been raised to join the viaduct forming the junction with the present London and Brighton. When this viaduct is finished, upwards of three millions of bricks will have been used. It consists of twenty-seven arches.—The Leeds and Carlisle will require a tunnel of 5,489 feet, or nearly $3\frac{3}{4}$ miles in length. It will also have to pass over a viaduct 500 yards in length, having 200 arches, the centre one being 130 feet high.—The *Courrier Francais* states that another event, happily, however, unattended by any serious results, has just occurred upon the Havre Railroad. A few days since, several cracks were perceived in the arch of the tunnel upon the great road to Harfleur. It had every appearance as though it would give way under the weight of the first train which might pass over it. The traffic was immediately stopped, and substantial repairs commenced. It is said that some large fissures are also visible in the Harfleur viaduct.—It is said that the coal mines of Mons have been purchased by the Northern Railway Company of France: but that the coal seams of Agrappe and Griseul, near Mons, have become the property of Messrs. Rothschild. The coal produced is of excellent quality; and, in consequence of the rapid progress of railways in the northern departments of France, forming junctions with those of Belgium, this will be a good speculation.

ENGINEERING.

*War Steamer, Sphinx.*—The following are the dimensions of this war steamer lately launched at Woolwich:—

| | Feet. | Inches. |
|---|---|---|
| Length between perpendiculars ... ... | 180 | 0 |
| Keel for tonnage ... ... ... ... | 156 | 5½ |
| Breadth extreme ... ... ... ... | 36 | 0½ |
| Breadth for tonnage ... ... ... ... | 35 | 8½ |
| Breadth moulded ... ... ... ... | 35 | 0½ |
| Depth in hold... ... ... ... ... | 30 | 11 |

Burden in tons, 1,061 12-94; 500-horse power.

*The Amphion Steam Frigate.*—This vessel has recently been launched from the government dockyard: the following are the principal dimensions:—

| | Feet. | Inches. |
|---|---|---|
| Length of the lower deck ... ... ... | 177 | 0 |
| „ „ keel for tonnage ... ... | 152 | 5⅜ |
| Breadth extreme ... ... ... ... | 43 | 2 |
| „ for tonnage ... ... ... ... | 43 | 8 |
| „ moulded ... ... ... ... | 42 | 8 |
| Depth in hold ... ... ... ... ... | 13 | 4½ |

Burden in tons, old measure, 1473 66-94ths.
„ „ new 973 141-3500ths.

The *Amphion* was commenced in 1830, and was partly built on the lines of the *Castor*, but has since been lengthened by the bow, and made suitable for the application of a screw propeller. The *Amphion* is to be fitted with engines of 300-horse power by Messrs. Miller and Ravenhill, the whole of her machinery will be considerably under the water line, and consequently not liable to be damaged by shot. The screw will be 15 feet in diameter, on Ericson's principle, attached to engines on the direct action principle, with four feet stroke, performing 48 revolutions per minute. The boilers will also be under the water line.

*The Fury Steam Frigate.*—The following are the chief dimensions of this new steam frigate:—

| | Feet. | Inches. |
|---|---|---|
| Length, extreme ... ... ... ... | 214 | 6 |
| Length between the perpendiculars ... ... | 190 | 0 |
| Length of keel for tonnage ... ... ... | 166 | 0¾ |
| Breadth, extreme ... ... ... ... | 36 | 0 |
| Breadth for tonnage ... ... ... ... | 35 | 8 |
| Breadth, moulded ... ... ... ... | 38 | 0 |
| Breadth to outside of paddle-boxes ... ... | 57 | 4 |
| Depth in hold ... ... ... ... ... | 21 | 0 |
| Burden in Tons, 1,123 58-94 | | |
| ENGINE-ROOM. | | |
| Length of engine-room ... ... ... | 47 | 0 |
| Width of ditto ... ... ... ... | 33 | 8 |
| Depth of ditto ... ... ... ... ... | 21 | 0 |
| Diameter of paddle-wheels ... ... ... | 26 | 6 |

Registered tonnage of coal-room, 461.77.

Armament — two 68-pounders, two long 42-pounders, and two 42-pounder carronades. Engines, 500-horse power.

*Iron Steam Frigate, Birkenhead.*—This vessel has been designed and built by Mr. Laird, of Birkenhead. She has a fine mould, is round sterned, clencher built below water line, and carvel built below her top-sides. The following are the principal dimensions:—

| | Feet. |
|---|---|
| Length between perpendiculars ... ... | 210 |
| Breadth within paddles ... ... ... ... | 37½ |
| Breadth outside paddles ... ... ... | 60½ |
| Depth of hold ... ... ... ... ... | 23 |

Tonnage (Carpenter's measurement) 1,400 tons.

The engines of 560-horse power will be constructed by Messrs. George Forrester and Co. This frigate will carry two 96-pounder pivot guns, and four 68-pounder broadside guns.

*Destruction of Hawthorne's Locomotive Factory by Fire.*—Hawthorne's factory, at Newcastle, has been destroyed by fire, by which damage has been done to the extent of from 16,000*l.* to 20,000*l.* The origin of the disaster cannot be clearly made out, but the fire was discovered by the watchman a short time after he had let out one of the joiners who had been working late, and it is believed that the accident originated in his carelessness or inadvertence. The flames spread with great rapidity: the gas-pipes within the building were melted, and the issuing gas added to the volume of the flames. The supply of gas could not be shut off, as the stop cocks were within the building, and the pipes had to be broken and plugged some distance off. Much inconvenience will be sustained by the stoppage of the works from the impossibility of keeping the time stipulated in the contracts for engines, and the firm is said to have contracts enough to keep them fully occupied for three years. The factory it is understood is insured, but not to the full amount.

MISCELLANEA.

Mr. Mackain, C.E., in a paper in the *Glasgow Philosophical Transactions*, states some strong reasons for believing that water is as compressible as air under the application of proportional forces; and assuming it to be so, he concludes, that bricks might be found floating at a depth of 28,330 feet; granite at 56,000 feet; and cast iron at 200,000 feet, or 39 miles.—The new batteries which are about to be erected at the northern extremity of Liverpool Docks will be so situated as to cross their fire with that of the fort on the Rock Perch, and to command both the narrow channels by which alone Liverpool is accessible to a hostile force. Should a war take place (says the *Liverpool Times*) we shall probably have our share of block-ships, as they are now called—that is, floating batteries to strengthen the land batteries, and thus protect the port from the possibility of annoyance.—The Belgian papers state that the demolition of the *British Queen* steamer in the basin at Antwerp is being proceeded with very actively. The materials will, it is probable, be employed in the construction of another vessel of more manageable dimensions.—The paddle-box boats of the Retribution have been found to be so heavy and unmanageable that leave has been given to return them to the dockyard; lighter ones are to be constructed in their stead. The boats, without gear or shifting thwarts, weigh four tons each; and the two with their gear and davits, weigh 12 tons!—M. Guillemon, an officer of engineers in France, has conceived the project of making a railway which shall unite the Mediteranean with the Channel, along which may be transported ships and fleets of war from the one point to the other on occasion.—Of the quantity of iron produced in Great Britain, South Wales produces 272½ thousand tons, Staffordshire 119½, Shropshire 81¼, Scotland 37¾, Yorkshire 33, Derbyshire 22½, and North Wales 25. The quantity has increased 100,000 tons per annum.—A national subscription is set on foot in France for an equestrian statue of Joan of Arc, in the city from whence she took her warrior-name—Orleans; the municipal council of which town has given 20,000 francs.—A number of masons, bricklayers, and carpenters, have left the Duchy of Modena, to settle in Algiers, as the government have put forth, that the wages of one of the above artisans at Algiers are five francs a day, equivalent to seven or eight at Paris or other crowded cities.—As the workmen were excavating for some cellerage in front of houses now building by Mr. Harding, in the Fulham-road, a spear head of copper was found 16 inches long, with a blade of 2 inches wide projecting from a taper hollow tube of 1 inch to a fine point. The copper was so decayed, as to crumble when touched. It was found 12 feet from the high road, nearly opposite the gate of the Earl's Court Cemetery, about 4 feet 6 inches from the surface of the ground.—The London and Birmingham Railway Company have presented 150*l.* towards the repairs of the church of St. John, Coventry. This is the only church in Coventry without a steeple.—A Russian company has obtained from the Persian government, for a small annual payment, the privilege of working the turquoise mines of Nichapour, in the province of Khorassan. The stones found there are the finest in the world for quality and size.—Recent arrivals of ships from Australia have introduced a new article of food into the London market. It is a kind of concentrated gravy, the result of the boiling of sheep and cattle for the supply of the English tallow market, and which has hitherto been of little or no value. It is imported in a good state of preservation, and on the addition of a few condiments, makes a very palatable soup. It is contained in tin canisters of about 3lbs. weight, which have found ready purchasers at 3s. each.—Gun carriages are in progress of construction for the Centaur steam-frigate, and for the Fury steam-sloop recently launched at Sheerness; and preparations are also making to arm the vessels in Her Majesty's navy, from the largest down to the very smallest in commission.—Liebig, the well-known chemist, has just been created Baron by the Grand Duke of Hesse-Darmstadt.—Any one may satisfy himself of the presence of ammonia in rain by simply adding a little sulphuric or muriatic acid to a quantity of rain-water, and by evaporating this nearly to dryness in a clean porcelain basin. The ammonia remains in the residue, in combination with the acid employed, and may be detected either by the addition of a little chloride of platinum, or more simply by a little powdered lime, which separates the ammonia, and thus renders sensible its peculiar pungent smell.—There are building and outfitting on the Clyde at present 37 vessels, amounting in the aggregate to 18,027 tons. Of these 26 are iron steamers, collectively amounting to 14,137 tons, and 5580 horse-power, the residue being timber ships, amounting to 3890 tons. Valuing the timber vessels at 20*l.* per ton, the iron steamers at 25*l.* and the machinery at 40*l.* per horse power, over head, the total value of these vessels when ready, and equipped for sea, will amount to 654,425*l.*—A new potato-digger was recently exhibited in operation at Salem, West Jersey. It threw out upon the ground, with two horses, at the rate of five or six acres per day, and as fast as thirty hands could pick up and carry them away.—Take two drachms of dried leaves of Belladonna cut in small pieces: throw them on live coals, and let the patient breathe the fumes which arise from them. This is, according to the experiments of M. Schroëder, the most efficacious method of procuring the immediate cessation of pulmonary hemorrhage.

# THE ARTIZAN.

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## Art. I.—NOTES ON LOCOMOTIVE ENGINES.

The boiler is the most important part of the locomotive engine, and the useful effect of the machine depends in a great degree on the boiler being capable of generating the requisite quantity of pure steam, without requiring the draught of air and flame through the fire and tubes to be accelerated or forced excessively. The fire-box is that part of the boiler in which the heat is generated and partially absorbed, the remaining absorption taking place in the flue tubes, which convey the products of combustion from the fire, through the water, to the smoke-box, whence they are dissipated in the atmosphere. Of course the more nearly these products of combustion, at their entrance into the chimney, are found to have been cooled down to the temperature of the water in the boiler, the more economical in fuel the boiler will, *cæteris paribus*, be. To obtain the utmost economy in this way, the superficial surface of the tubes has been increased to the utmost extent, by diminishing the diameter and increasing the number and length of the tubes. The boiler of Bury's 14-inch cylinder engine contains 92 tubes of $2\frac{1}{8}$ in. external diameter, and 10 ft. 6 in. long: the boiler of Stephenson's 15 inch engine contains 150 tubes of $1\frac{5}{8}$ in. external diameter, and 13 ft. 6 in. long. It will therefore be seen, that the superficial surface in Bury's tubes is, comparatively, rather small, but yet the production of steam is found to be sufficiently copious, with a blast-pipe of rather more than the average diameter; on the other hand, notwithstanding its great surface, Stephenson's boiler is found to require a smaller blast-pipe than usual. It seems highly probable that the extra intensity of blast requisite in the latter case consumes so much power to produce it, as completely to countervail the economy of fuel consequent on the very complete abstraction of heat, by the great length of tubes in proportion to their diameter. If made very small, the tubes are liable to be choked by pieces of coke, and the sectional area will be inconveniently contracted, while, if made much larger, the heating surface will be unduly diminished. The number of tubes varies considerably in different boilers; in one species of locomotive, in extensive use, the number is 134, and the pitch $2\frac{1}{4}$ in. Sufficient space is left below the tubes for deposit, that it may not be in contact with the tubes, and cause them to be burned: the extreme tube of the widest row is about the diameter of a tube from the boiler shell. In the long-boiler engines of Stephenson, from the volume of water contained in them, considerable time is required to get up the steam, even so much as three and a half hours, where the ordinary engines take two hours, and they require great care in firing and feeding to prevent the steam running low. The ferules or tube-rings, which are driven into the tube-ends to make the points of junction steam and water tight, are found to be very injurious to freedom of draught, particularly in very small tubes; and to overcome this objection, numerous methods have been tried for fastening the tubes in by rivetting over or screwing into the tube-plates, but hitherto no method, except that of internal tube-rings, has been found to answer in the case of brass tubes; but we think it likely that, with wrought-iron tubes, internal tube-rings will be ultimately abandoned. Stephenson has frequently adopted iron tubes of late, in preference to brass, on the score of their greater cheapness and durability; and in some cases, where unusual attention has been paid to them, and pure water used, they have been found to answer very well.

The blast pipe is the eduction pipe diminished in area at the mouth to such a degree as to cause the steam to issue with a great velocity, whereby a powerful draught through the fire is maintained by the steam rushing up the chimney. The area of the mouth of the blast pipe varies in different engines, but an area of 1-22nd of the area of the cylinder is a common proportion. A variable blast pipe, the orifice of which may be increased or diminished in area, is now much used. One arrangement for this purpose consists in the application of a regulator plate at the top of the blast pipe, with a hole through the centre of the plate, through which the nozzle of the blast pipe passes. When this regulator plate is closed, the whole of the steam has to ascend through the central nozzle; but when the regulator is open, or partly open, a part of the steam escapes through the holes in it. Another plan consists in the application of a moveable plug within the blast pipe, which may narrow the escape orifice to an annular space of small area, the plug being raised or lowered by a lever and rod. Stephenson's method of contracting the blast, consists in making the nozzle of the pipe conical, and forming it to slide within the upright pipe, whereby an annular space is left for the escape of the steam around the nozzle when the nozzle is lowered. This appears to be a preferable plan to either of the preceding.

The shell, which is cylindrical, is attached to the smoke-box and fire-box by angle iron; the end of the shell next the smoke-box is closed entirely by the tube plate, but at the fire-box end the water has free access quite round the internal fire-box, one side of which forms the tube plate. The shell, external fire-box, and the smoke-box are always of iron, the thickness of plate being 5-16 in. in ordinary boilers of 3 ft. to 3 ft. 4 in., though in some cases it is $\frac{3}{8}$ in.; the pitch of rivets is $1\frac{7}{8}$ in., and the diameter of rivets 11-16 in. The shell is sometimes made with flush joints, a band of iron covering the joint attached by two rows of rivets. The boiler plates should have their fibres running round the boiler instead of in the direction of its length, as the plate is somewhat stronger in that direction. The boiler is secured endwise by longitudinal stays, which are fastened by cutters to jaws attached to the end plates.

Iron fire-boxes have been extensively tried by Bury and other manufactures of locomotives, and in cases where the plate-iron of which they were formed has been of peculiarly perfect texture, and not liable to laminate or crack under the action of the heat, they have been found to answer exceedingly well, and not only to be much cheaper than copper, but also to last at least twice as long before requiring renewal; if the materials be very carefully selected, the use of iron fire-boxes will be found productive of economy, if only used in situations where pure water is obtainable. The duration of ordinary copper fire-boxes depends in a great measure upon the original texture of the copper, which ought to be rather coarse-grained than rich and soft, and also particularly free from irregularity of structure and lamination. Considerably advantages have been found to arise from increasing the capacity of the fire-box, more especeially its depth, which ought to be such as to allow of the requisite quantity of coke being placed within it, without reaching above the mouths of the lower tubes, a fault which would cause the smaller pieces of coke to enter and block up the tubes, to the manifest deterioration of the draught, and diminution of the efficacy of the engine. The heating surface in the fire-box being of an extremely valuable and efficient nature, and the extensive area of fire-bar surface being very conducive to freedom of draught, we are induced to question whether the large square fire-box is not *pro tanto* preferable to the round one, which must necessarily be very small, except on the 7-feet gauge, in which case the round fire-box offers decided advantages. The square fire-box is generally made of iron, $\frac{3}{8}$ in. to $\frac{1}{2}$ in. thick in every part except the tube plate, which has been from $\frac{5}{8}$ in. to $\frac{3}{4}$ in.; but experience has shown considerable advantage in making the tube-plate $\frac{7}{8}$ in. thick, as this great strength prevents the spaces between the tubes from being compressed, and the tube holes rendered oval, in the processes of drifting and feruling the tubes; however, this evil will be found to exist, even with a $\frac{7}{8}$ in. tube-plate, if the tube holes be placed in too close contiguity, as has been found the case in several of Stephenson's engines; and, from practical observation, we find that $\frac{3}{4}$ in. should be the minimum distance beteween any two tubes. The sides, back, and front below the tubes, of the square fire-box, are stayed at intervals of $4\frac{1}{2}$ in. to 5 in. with either copper or iron stays, screwed through the outer case into the fire-box, and securely rivetted; but, as the rivetting within the fire-box is found to decay rapidly, from the action of the heat, Mr. Dewrance, of the Liverpool and Manchester Railway, has adopted, with good results, stays formed with a large square head, and screwed from within the fire-box outwards, the square head projecting 2 in. into the flame. Iron stay-bolts for the fire-box are found to last nearly as long as copper, and, from their superior tenacity, are often considered preferable. Until lately, it had been supposed that round fire-boxes possessed such advantages in point of strength over square ones, owing to their arched form, that they were capable of resisting the pressure of the steam without the use of stays; but experience has shown that, whatever be the shape, a fire-box must be stayed more or less to render it safe, for the shell of the fire-box is liable to be wasted so much by the heat, that it is not safe to depend altogether upon the strength its form confers, especially as the form will be changed if the boiler be suffered to become short of water. In round fire-boxes, the sides near the crown part generally suffer most from waste: these portions are now provided with stays by Messrs. Bury, Curtis, and Kennedy, who are the main supporters of round fire-boxes; and with this provision, the round fire-boxes are necessarily the stronger. The roofs of all fire-boxes require to be stayed by cross-bars; but the bars are required to be both stronger and more numerous for the square fire-boxes, and should always be carefully made of wrought-iron, and vary carefully fitted before being bolted on. Stay-bars of cast-iron have been employed, on account of their cheapness, but, having led several times to accidents from explosion, they are now discarded.

The fire-bars have always been a source of much expense in the locomotive engine, as they burn out very rapidly, and have to be often renewed; from the rapid combustion going on over their upper surfaces, they become heated intensely throughout, causing them to throw off scale, and to bend under the weight of the fuel. The best remedy has been found to consist in making the bars very thin and deep, so as to keep their lower edges exposed to a cooling draught of air, and to diminish the area of metal conducting heat downwards from their heated upper edges. Thin fire-bars admit of being placed nearer together than thick ones, thus offering no increased impediment to free draught, while preventing the loss of small pieces of unburnt coke, which might otherwise drop through into the ash-box, and be wasted. Fire-bars have given much satisfaction when made 4 in. deep (parallel) and full $\frac{5}{8}$ in. on the upper edge, and $\frac{3}{8}$ in. on the lower edge. The frame carrying the fire-bars has often been made capable of being dropped on the instant, with its fire-bars and fire into the ash-box, or upon the road, by means of catches drawn back by levers; hut though the fire-bar frame is thus left unsupported, very often it will not drop, and even cannot be forced down out of its place, owing to the clinkers and tarry products of combustion forming an adhesive binding between its edge and the fire-box; it has accordingly been found best to support the fire-box frame permanently, and when any cause requires the sudden withdrawal of the fire, to lift the fire-bars singly out of place, by means of the ordinary dart. It is necessary to place the fire-bars with their upper surface about 3 in. higher than the bottom of the water-spaces, which, by this means, will be allowed to contain quiescent water, ready to retain without injury any deposit that subsides from the water, and the water-spaces should be periodically cleansed, by means of the mud-holes placed opposite the edge of each water-space in the lower part of the outer fire-box shell. These mud-holes are made water-tight, by means of either a brass plug simply screwed in, and with a slight taper, or by a door applied, with a soft packing on its face, and screwed up with a bridge-piece and bolt, making the joint on the internal surface of the outer shell, the hole and door being made sufficiently oval to enable the door to be introduced into the water-space. The latter plan often gives rise to inconvenience, from the joint being found leaky when the steam is raised, rendering it necessary to drop the fire, and empty the boiler, before it can be renewed. In some very large square fire-boxes, such as those used on the Great Western Railway, a diaphragm, or divisional 4-inch water-space, has been placed across the middle of the fire-box, with the view of obtaining increased heating surface. This diaphragm has its lower edge (in which deposit takes place) made straight, and about 2 in. below the general surface of the fire-bars, but its upper edge is of the form of an inverted arch, in order to promote the free delivery of the steam generated within it in to the steam-dome. The sides of the fire-box, where the diaphragm is attached, are not cut away to form passages for the water and steam, but are pierced with a series of circular holes, 3 in. in diameter, to permit a due circulation without uselessly weakening the fire-box; but the uppermost hole of the series must be placed at the highest point of the diaphragm, otherwise an accumulation of steam, and consequent injury at that point, will ensue. The use of a diaphragm is found to be beneficial in the case of a very powerful engine, provided its upper edge be made sufficiently low to admit of the tubes being conveniently drifted over it, and to allow the dart to be used with facility, in dropping the front set of fire-bars.

The ash-box consists of a plate-iron tray, placed below the fire-box, to receive the burning ashes that drop from betwixt the fire-bars. In the earlier locomotives, no ash-boxes being used, the red-hot ashes were dispersed to a considerable distance by coming in contact with the wheels, and conflagrations were often thereby originated. The ash-box should be as large as convenient, and not less than 10 inches deep, otherwise it will materially impede the draught; but if of ample dimensions, and closed at the sides and back, it will increase the draught, particularly when running against a head wind, at which time a strong draught is required. A hanging shutter to open or close the front of the ash-box forms a good damper. The bottom of the ash-box is placed about 9 inches above the level of the rails, and should on no account be nearer than 6 inches, otherwise the engine could not pass safely over stones or similar objects lying accidentally between the rails.

The smoke box door is hinged at the bottom, and is kept shut by means of handles and catches; but the position of the door, when open, is in that case inconvenient. In some of Stephenson's engines, the smoke box door is in two leaves, which open like the doors of a house, overlapping at the centre, where they are closed by a bar, and at top and bottom by handles and catches. This door admits of the easy examination of the cylinders and valves. A small door is usually left near the bottom of the smoke box, by which the acummulated ashes may be removed. The bottom of the smoke box should not be so low as the ash pan, or be much nearer the level of the rails than 18 inches, as the blowing through cocks of the cylinder project through it, and would be liable to injury from objects lying on the line. The smoke box is lower in goods engines than in passenger engines, on account of the driving wheels being smaller, and, being coupled with the other wheels, the cylinder has frequently to be inclined to let the moving parts work clear of the front axle.

The chimney must not stand more than 14 feet above the rails. It is sometimes covered with a bonnet of wire-work to prevent the passage of cinders, but such wire-work checks the draft, and is soon worn away and broken by the projected coke, and a perforated plate is sometimes substituted, which is set across the smoke box and below the blast. This plate should be hinged, and in two leaves, for the sake of convenience. The sectional area of the chimney is about 1-10th of the area of fire grate. The chimney is usually provided with a damper, similar to the disc throttle valve of an ordinary engine; this is generally hung off the centre, and a hole made in it for the top of the blast pipe, which projects through it when it is closed. Another damper has been applied by Messrs. Rennie at the smoke box end of the tubes, consisting of a sliding plate perforated with holes, which when opposite the ends of the tubes will give a free current, and may be made to close them completely if required. Another kind of damper consists of an arrangement of thin bars similarly disposed to the laths of a Venetian blind; the plates being so hinged, that when placed with their edges to the tube plate, they leave the flow of air through the tubes unimpeded, and when hanging down they close up the tubes, or they partially close the tubes in any intermediate position. By either of these arrangements, the hot air is retained for a longer period in contact with the tubes than if a simple damper were used, as each tube is virtually furnished with a hanging bridge which keeps in the hottest air and only lets the coldest flow out. An inconvenient degree of heat in the smoke box is also prevented. The smoke box is usually made of $\frac{1}{4}$ plate; the chimney of $\frac{1}{8}$ plate; the blast pipe of $\frac{1}{8}$ copper, and the steam pipe of 3-16ths copper.

The man-hole, or entrance into the boiler, consists of a circular or oval aperture of about 15 in. in diameter, placed by Bury at the summet of his dome, and by Stephenson in the front part, a few inches above th cylindrical part of the boiler. The cover that closes this aperture in Bury's engine also contains the safety valve seats, thus simplifying the construction by preventing the necessity of an independent aperture and cover for the safety-valves, as in Stephenson's engine, where the safety-valves are placed independently on the top of the dome. The steam-tight joint of the man-hole cover is made in Bury's engine by a single thickness of canvass, smeared with red lead; and the joint is not liable to become defective or leaky, because the surfaces are turned true and smooth, both on the cover and its seat. When these surfaces have not been made true in this manner, it becomes requisite to use a number of thicknesses of canvass, or other material, to form the joint; and the action of the steam soon rotting away the soft substance, a leakage is caused through the joint, which makes repair indispensable. The small domes of the same form as those used on the Grand Junction Railway, which are cylindrical vessels of about 20 in. in diameter, and 2 ft. in height, with a semiglobular top, are generally made of plate iron, of about 3-8ths of an in. thick, welded at the seam, and with the flange at the bottom turned out of the same piece. In some cases, domes of this form have been constructed of cast-iron, about $\frac{3}{4}$ in. thick, but they have been found objectionable from their top weight, and they cannot be considered as altogether safe from explosion.

The steam-dome, or separator, from the upper part of which the supply of steam is obtained, is now generally placed over the fire-box; and in Bury's and Stephenson's engines it forms a part of the external shell of the fire-box; whilst in the engines used on the Grand Junction Railway, it consists of an independent cylindrical vessel, attached to the low roof of the fire-box. Either this latter plan, or Bury's, is perfectly safe and strong, without the addition of stay-rods; but Stephenson's dome presents a large extent of flat surface, from the roof of the internal fire-box up to the arched roof of the external fire-box; and this flat surface requires to be powerfully stayed by angle-irons and tension-rods. The accidental omission of one of the numerous tension-rods has led to the forcing out and partial explosion of the side of the fire-box, showing how much depends on the circumstance of these rods, with their joints and pins, remaining sound and uninjured from corrosion or other source of injury or decay. In this respect, the round fire-box, with its dome, as formed by Bury, has the advantage of superior strength and safety. A large steam-dome is found to be the most-efficacious mode yet tried for preventing the evil of priming or damp steam; but no height of dome will entirely prevent it if there be not space enough left above the tubes in the cylindrical part of the boiler to allow the free passage of the steam along to the fire-box and dome, while an excessive height of dome is also found to produce an unsteady motion of the engine, by causing the machine to be top-heavy. A height of about 2 feet 6 inches above the cylindrical part of the boiler is found to give satisfactory results in practice, and to lead to the production of as pure steam as any greater altitude could secure. In some engines the steam is withdrawn from a dome placed at the smoke-box end of the boiler, into which the steam-pipe rises. It is thought that the ebullition being much less violent at this point, the steam will be more effectually dried. The steam-pipes are made either of iron or copper, and of these iron best withstands the high temperature of the smoke-box and the impact of the cinders, but it is liable to internal corrosion. The steam-pipe, after entering the smoke-box, divides into two branches, one passing down each side of the smoke-box so as to leave a free space for cleaning the tubes, and also to avoid as much as possible the impact of the hot air and cinders, but in some engines the steam-pipe descends vertically, which is found to be inconvenient in practice. The area of the steam-pipe is one-sixth to one-eighth of the area of cylinder, and the branch steam-pipes are each about one-tenth of the area of cylinder.

The admission of the steam from the boiler to the cylinders is regulated by a valve regulator, which is generally placed immediately above the internal fire-box, and is connected with two copper pipes, one conducting steam from the highest point of the dome down to it, and the other conducting the steam that has passed through it along the boiler to the upper part of the smoke-box. Regulators may be divided into two sorts, viz. those with sliding valves and steam ports, and those with conical valves and seats, of which the latter kind are the best. The former kind have for the most part hitherto consisted of a circular valve and face, with radial apertures, the valve resembling the out-stretched wings of a butterfly, and being made to revolve on its central pivot, by connecting links between its outer edges or by a central spindle. This species of regulator is easily worked, but it is not very accessible, and as the faces are merely projecting rims round the holes, the steam will leak through, and the engine may go on unless the regulator be critically closed. In some of Stephenson's engines with variable expansion gear, the regulator consists of a slide valve covering a port on the top of the valve chests. A rod passes from this valve through the smoke-box below the boiler, and by means of a lever parallel to the starting lever, is brought within the engineer's reach. Cocks were at first used as regulators, but were given up, as they were found liable to stick fast. A gridiron slide valve has been used by Stephenson, which consists of a perforated square plate moving upon a face with an equal number of holes. This plan of a valve with a small movement gives a large area of opening. In Bury's engines a sort of conical plug is used, which is withdrawn by turning the handle in front of the fire-box; a spiral groove of very large pitch is made in the valve spindle, in which fits a pin fixed to the boiler, and by turning the spindle an end motion is given to it which either shuts or opens the steam-passage according to the direction in which it is turned. The best regulator would probably be a valve of the equilibrium description, such as is used in the Cornish engines.

The safety-valves are placed upon the dome in Bury's and Stephenson's engines; but it has been found much better to place them on the cylindrical part of the boiler, as is the arrangement in the engines constructed by Mr. Dewrance for the Liverpool and Manchester Railway, because when an engine commences to prime, the water projected from the blast-pipe generally causes an unusual generation of steam, which escapes at the safety-valve, and in its passage of course accumulates and lifts the surface-water and foam at whatever point of the boiler the safety-valves are situated; thus the farther they are placed from the steam-dome the better, as they will then diminish the evil of priming, which, if placed upon the steam-dome, they would only aggravate. Indeed, if the safety-valves are properly situated, an engineman has the great advantage of being able to check or stop the priming of the boiler on the instant, by causing his safety-valves to blow off strongly. It is requisite to place the safety-valves upon a tubular pillar of such altitude as to prevent the escaping cloud of steam from obscuring the look-out of the engineman. Bury's 14in. engine contains a pair of safety-valves of 2½in. diameter, exclusive of the mitre; and Stephenson's 15 in. engine contains a pair of 4 in. diameter. The latter dimension is preferable, as large safety-valves are much less liable to adhere to their seats than small ones. Safety-valves require to be tested occasionally, and the best method consists is attaching the valve joint-pin to one end of an ordinary pair of scales, when the over-balancing weight at the reverse end will indicate the real pressure upon the valve, which exceeds the nominal pressure by the weight and friction of the lever, with its joints and spring-balance, and the adhesion of the valve to its seat. To bring this adhesion to a mimimum, it is a good plan to make the lip of the valve-seat rather flatter than a mitre, that is, at a less angle than 45 deg. with the horizon: 30deg. answers very well. The whistle is placed on the dome, and is sometimes jointed by running melted lead between its flange and the dome-plate; but it is better to fit the surfaces so truly together as to be steam-tight merely with the assistance of one thickness of fine canvass, coated with read lead or cement, for lead will always be found to decay by contact with high-pressure steam, making continual renovation necessary. This remark equally applies to the other joints connected to the shell of the boiler, such as the gauge-tube, blow-off cocks, and feed-pipes.

## Art. II.—PRACTICAL REMARKS ON MARINE BOILERS.

The proper arrangement of heating surface in a boiler, so as to prevent the overheating of the plates, is very important. Surfaces exposed to a high temperature should always be so made that the steam might disengage itself easily from the metal, for if it be retained in contact with it for any considerable time, the access of the water will be prevented, and the plate will become overheated in consequence. The vertical sides of high furnaces are often greatly damaged from this cause: the steam is retained among the landings of the plates, and other irregularities of surface, and the sides of the furnace become buckled and drawn, from the iron becoming overheated. It is very expedient, therefore, to make all furnaces of marine or locomotive boilers wider at the bottom than at the top. The landings of the plates should also be made so as to prevent the possibility of steam being retained in them. The aftermost tube plate should be set at a slight angle, to facilitate the liberation of the steam; and as the tubes will thus be somewhat off the horizontal, any water which may escape by leakage will run into the furnace, instead of incommoding the firemen, by running out of the smoke-box doors.

The whole of the shells of boilers intended to withstand any considerable pressure should be double rivetted, with rivets 2⅜ inches from centre to centre; the weakening effect of double rivetting being much less than that of single rivetting. The furnaces above the line of the bars should be of the best Lowmoor or Staffordshire scrap plates, ⅜ths thick, and each furnace above the bars should consist of three plates, one for the top, and one for each side; the underseam of the side plates being beneath the level of the furnace bars. The tube plates of tubular boilers should be of the best Lowmoor iron, ⅞ths to one inch thick: the shells should be of the best Thornycroft S crown iron, or of Staffordshire iron, of good quality, and 7-16ths thick, at the least. Angle iron should not be used in any part of a boiler, as in the manufacture it becomes reedy, like wire, and is apt to split in the direction of its length. It is a much safer dependence to bend the plates, if it be carefully done, and without any more sharp turns than can be helped; but it is convenient to use a little angle iron about the furnace mouths, which should be of the first quality. The whole of the plates of boilers should be punched with a double punch, one nipple of which enters the hole last punched while the other punches the hole, and it is very convenient to have the punching press provided with a travelling table whereby the operation of punching and paring the edges of the plates is made a self acting one. The use of drifts and screw-jacks in putting the parts of boilers together should not be permitted. The rivets should be of the best Lowmoor iron, 11-16ths in diameter. The whole of the work should be caulked both inside and outside so far as it is accessible: the parts may then be washed over with a solution of sal ammoniac, and the rivets and landings above water painted over with a mixture of whiting and linseed oil. It is very desirable that the space between the furnaces and tubes of tubular boilers should be sufficiently large to enable a man or boy to get in. The bend joining the top of the furnace at the after end, with the bottom of the tube plate, is very liable to get burnt away, and its repair will be most difficult, unless made accessible from the inside to hold on the rivets. The boilers of the *Sydenham* shown in a former number of the "*Artizan*," are very judiciously formed in this as well as in most other respects; it appears expedient, however, to shield this and any other such exposed parts, where the heat acts injuriously upon the iron, by means of fire blocks moulded to the place and secured by nuts sunk into dovetailed recesses in the substance of the blocks, which recesses are finally filled up with fine clay. In new boilers even, such an application is most expedient in situations in which injury to the iron from the impact of flame is experienced or apprehended. The plate on the furnace side of the waterspace at the end of the boiler should be inclined considerably towards the tubes to facilitate the ascent of the steam, and it appears to be the preferable way to round off the top of the chamber leading from the furnace to the tubes, as in the case of the *Braganza's* boilers, as a greater strength of iron is thus got between the holes in the end plates without diminishing the facility of scaling the tubes or introducing any instrument down between them to keep the spaces clear.

The tubes of boilers are most generally secured at the ends by means of ferules driven tight into them, the holes in the end plates being usually countersunk, and a corresponding projection being made on the ferules. The ferules next the furnace are best made of steel, while for the other ends malleable iron ferules answer as well. The tool in which the ferules are made consists of three pieces; one piece is set on the anvil and consists of a flat plate with a nipple on it rising to half the depth of the ferule and rounded at the corners; the next piece consists of a ring furnished with a handle, and with its lower edge recessed slightly into the flat plate so as to steady it, and this ring is larger in its internal diameter than the nipple by twice the thickness of the ferule; the last piece consists of another nipple made like the first but formed with a head like a punch. A small hoop is formed by welding a piece of steel or iron, and is dropped into the space between the interior of the ring and the lower nipple; the upper nipple is then forced down by striking the punch head with a forge hammer, whereby the ferule is moulded to the right form; the parts are finally taken asunder whereby the ferule is liberated.

In brass tubes, the use of ferules appears to be indispensable, but in the case of stout iron tubes, such as Russell's patent boiler tube, they are unnecessary, and the best plan when iron tubes are used appears to be to widen one end of the tube slightly and to drive the tube in from the front of the boiler into both tube plates, the holes in the front plate being made 1-16th wider than those in the back plate, and the tube being widened correspondingly. Before the tubes are driven in the holes in the tube plates must be slightly countersunk, and the tubes must finally be carefully rivetted in. It will be expedient to screw a few of the tubes into the tube plates, instead of rivetting them, so as to serve as stays, and also as abutments to rivet the rest of the tubes against. The screwed tubes should be left a little longer than the others, and thin nuts, made of boiler plate, should be screwed upon the projecting ends to prevent leakage and add to the security of staying them. In fitting in the tubes in this way great care is necessary to make them perfectly tight; and it will be expedient to turn the ends slightly in the lathe to give them a trifling taper, and make them all of precisely the same size; in driving them in, each tube should not be driven home at once, as that will spring out the iron between the holes, but they should be all fitted in first with the common chipping hammer, and when thus all equally fitted, they should be driven home by a heavy hammer or ram; the countersink in the holes must be but slight, and must be filled rather by rivetting up endways than by rivetting over. In some cases boilers are made with collars rivetted on the tubes immediately behind the tube plates, but this plan is attended with the objection that a tube cannot be renewed without taking the boiler asunder, and with the still greater defect, as it appears to us, that the ends of the tubes will be liable to get burned away in consequence of the internal collar preventing the access of the water: boilers formed on this plan, therefore, will, we believe, be found to become leaky at the ends of the tubes, and unless stayed, independently of the tubes, the tube-plates will be forced asunder by the pressure of the steam.

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## Art. III.—PARSEY'S AIR ENGINE.

We have visited the exhibition of this invention, which has lately been made the subject of considerable agitation, and the result has been to confirm our suspicions that the whole is a piece of quackery. We found on entering the room in which the working models were exhibited, a portion of it railed off to keep the spectators at a due distance from two model locomotives of small size, which ran up and down upon two small railways; and within this enclosure stood Mr. Parsey, to explain every quarter of an hour to the ladies and gentlemen before him the principle of the invention. Mr. Parsey has all the glibness of a person habituated to such displays, and does not appear to belong to that modest and retiring class from which useful inventors are, for the most part, recruited; but he has all the confidence of superficial attainments, and appears to think that he has demonstrated the perfection of his scheme, when he has overcome some feminine doubt, or silenced, by a rude reply, some modest objector. Mr. Parsey informed his auditory, that he stood there to explain his invention, and to answer any doubts or objections that might be raised. On the strength of this intimation, we ventured to ask a few questions, but Mr. Parsey was neither able to answer them, nor disposed to meet them fairly, and resorted to a shuffle to escape from the dilemma. We first asked Mr. Parsey what the pressure was at which he intended to work. He did not seem greatly to relish such a specific question, but replied, that any pressure might be used up to a hundred atmospheres. We next asked him in what way he met the inconvenience of the great rise in the temperature of the air from so great a compression, but Mr. Parsey maintained that no such inconvenience existed, as there was no rise in temperature. We were somewhat astonished at this new doctrine, as we conceived it impossible that Mr. Parsey should be so ignorant as not to be aware of this notorious truth in physics; and which is familiarly illustrated by the well-known syringe, which lights a piece of amadou, or German tinder, by the compression of the air shut within it; and we were unwilling to believe Mr. Parsey to be so unscrupulous an inventor as to invent facts as well as engines. We, therefore, reminded Mr. Parsey that even in the Atmospheric Railway, where the compression was inconsiderable, an inconvenient degree of heat was evolved, as appeared by Mr. Stephenson's report on that subject; while in Gordon's trials, made many years ago, to make gas portable by compressing it into copper flasks, the pumps were even made red hot; but Mr. Parsey repudiated Mr. Stephenson's authority, though not without the intimation from us, that in any contested point his authority would be reckoned the preferable one by the public. We were proceeding to other points, but Mr. Parsey said that it did not suit him to enter into such questions as we were raising for the present, but he meant to publish a book explanatory of his invention, where all such points would be disposed of, and we had therefore only to remark, that we should have to look to that book for the proofs he professed to furnish, and not to his present experiments and explanations. To set a little model running up and down a room by means of compressed air, we added, proved nothing, for the same might be done by watchwork and by other means, which no one pretended would be applicable in practice, and as we saw by placards stuck round the room, that a company was in process of formation, it appeared only reasonable, that if the necessary proofs of the utility of the invention were to be withheld until a book was published, the calls for money should be subject to a similar postponement.

Such was the substance of our conversation with Mr. Parsey, and its effect certainly has not been to raise either the invention or the inventor in our estimation. Whether compressed air is eligible, or otherwise, as an instrument of railway propulsion, is a question to be settled by figures and facts, and we cannot find that Mr. Parsey has contributed in any measure towards the solution of the problem. His whole merit consists in applying a cylinder and floating piston between the air reservoir and the engine, with the view of equalising the pressure in the working cylinders, but by this *improvement* he loses the expansive force of the air, and thereby wastes a large amount of the power. Some of these quantities we shall now endeavour to determine.

If 0 denote the density of the air, it appears from the experiments of Dalton and Leslie that $45\,(\frac{1}{0}-0)$ will denote the number of degrees of cold produced when the air is rarified to unity, or the number of degrees of heat that is produced when the air is compressed. If the air be compressed to 100 atmospheres, then $0=100$, and the formula becomes $45\,(\frac{1}{100}-100)=$ 4499.55 degrees, which the air will be raised in temperature during compression. From 1 to 100 atmospheres, therefore, will its temperature be raised to about the melting point of copper. A locomotive engine drawing 100 tons, at 30 miles per hour, evaporates 200 cubic feet of water in the hour, and exerts a power of above 200 horses. We shall suppose that Mr. Parsey's trains are lighter, so that a power of 100 horses would suffice to draw them, and we shall further suppose that he continues to draw the air from his air vessel until its pressure has declined to one atmosphere, so that it is, as far as possible, all made use of. The point at which he ceases to draw air from the air vessel, fixes the working pressure, which is to be at all times the same, whatever the pressure in the air vessel may be, and the pressure must therefore be reduced down to the ultimate pressure made use of, inasmuch as the ultimate pressure is not susceptible of increase. If the working pressure be one atmosphere, then 33 cubic feet of air, of twice the density of the atmosphere, will be required per horse power, or 66 cubic feet of the atmospheric density. Mr. Parsey proposes to take in air every 30 miles, or every hour, if the speed be 30 miles an hour; and if the quantity be 66 cubic feet per horse power per minute, the quantity of air required to be carried per train will be $66 \times 100 \times 60 = 396{,}000$ cubic feet. But this quantity of air will be compressed into one hundredth part of its bulk, the pressure being 100 atmospheres, so that the capacity of the air vessel with that pressure will be 3,960 cubic feet, or if it be a cylinder 8 feet in diameter, it will require to be nearly 80 feet long. To ascertain the thickness requisite for such a diameter of air vessel, and such a pressure of air is not very difficult. The diameter being 96 inches, and the pressure per square inch being 100 atmospheres = 1,170 lbs. per circular inch. Then $96 \times 2{\cdot}54 \times 1{,}170 \div 17{,}800$ the greatest strain a square inch section of iron will sustain without permanent derangement of structure=the thickness which, on reduction, will be found to be 16 inches. The greatest strain iron is subjected to in machinery is 4,000 lbs. per square inch, but in high pressure boilers the strain is occasionally somewhat greater than this, and to be liberal with with Mr. Parsey, we will call it 5,000 lbs. The diameter of the air vessel being 96 inches, and the pressure per square inch, 1,500 lbs., the force tending to separate the parts is $96 \times 1{,}500 = 144{,}000$ lbs. per inch in length of the air vessel. The sectional area per inch in length, therefore, must be $\frac{144{,}000}{5000}$ =nearly 29 square inches or $14\frac{1}{2}$ inches of thickness on each side. The gain of power from working steam engines expansively is represented by the Naperian logarithm of the expansion produced, and as an equivalent power is required for the accomplishment of compression, the loss of power in Mr. Parsey's arrangement must vary in the same proportion. The Naperian logarithm of 98, which may be taken as representing the expansion from 100 atmospheres to 2, is about 4·5, so that $4\frac{1}{2}$ times the power will be required to charge Mr. Parsey's air vessel, that he will subsequently obtain from it if he works in the manner he proposes, the residue being wasted in forcing the air through the contracted passages incidental to the arrangement for equalizing the pressure. If, therefore, Mr. Parsey's receivers be charged by means of a stationary engine, it will require to be $4\frac{1}{2}$ times more powerful than would suffice for the propulsion of the train. This computation is founded on the assumption that no loss is occasioned by the rise in the temperature of the air during its compression. A loss from that cause, however, would be sustained, though it might be prevented from rising to any serious amount by plunging the pump in water, and adopting other judicious means of refrigeration. If the engine were worked at a higher pressure than we have supposed, there would be less power lost from the opposition of the atmosphere; but a smaller capacity of the air-vessel would be available, as nothing under the supposed uniform pressure could be withdrawn from it.

Such then are the leading points of Mr. Parsey's scheme, divested of the golden tints of a prospectus, and brought to the test of figures before which so many fine fallacies crumble down. Instead of no heat being produced by the compression of the air, it appears that the temperature would rise at the first stroke up to the melting point of copper, and although we should not look upon this as an insuperable difficulty if material advantage were shewn to arise from other parts of the plan, yet we do not see how it is consistent with common honesty to attempt to conceal it. In the expansion of the air a corresponding degree of cold must be produced, which we anticipate would be found very inconvenient to the attendants upon the engines, and, perhaps, to the persons in the train. A loss of power would also be sustained by the inability of the air to acquire heat with sufficient rapidity during its expansion. The grand objection, however, lies in the size and strength requisite for the air reservoir. When people think it an advantage to supersede a locomotive boiler 15 feet long, 3½ feet in diameter, and ⅝ths of an inch thick, by an air boiler, 80 feet long, 8 feet in diameter, and 15 inches thick, Mr. Parsey may begin to hope that his project will be listened to—and not till then.

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## Art. IV.—CANDIDUS' LETTERS.

### LETTER II.*

While Industrial Art is exerting itself to bring taste and the tasteful within the reach of nearly all who are above the sphere of actual necessity,—while, by the substitution of cheaper materials, and more economic processes, it is providing the middling classes with elegancies that used to be within the reach of only the opulent,—at the very time that Industrial Art is advancing in this praiseworthy direction, doctrine is maintained by some which were it generally adopted and adhered to consistently, would at once put a stop to a great many modern, and some of them very recent inventions, that diminish the cost of ornamental works, both in regard to material and labour. The making use of artificial materials of any kind, no matter of how superior kind in themselves, has just been protested against equally dogmatically and contemptuously. Possibly the censure, or rather the sweeping and unqualified condemnation of the employment of any thing of the sort, as being inconsistent with the dignity of art and worthiness of construction in architecture, may proceed only from an individual. At any rate it is highly inimical to the interests of many manufactures that supply us with imitative materials, some of them rivalling the genuine, in appearance, also of those in which mechanism comes in aid of, if it does not entirely supersede manual labour.

Were objection urged only against what is paltry as well as deceptive—so obviously spurious as to amount to no deception at all, or against the abuse of imitative materials by employing them for what is paltry in design, it would be well founded and wholesome censure. Instead of this, it comes in the shape of indiscriminate and unmitigated reprobation of whatever is artificial or factitious as to its material, as being therefore spurious, sham, paltry, worthless, and "brummagem!" Yet merely in this there is a good deal of that kind of sham and deception called sophistry. Terms are taken as synonymous, as identical in meaning, which are intended to express very contrary ideas. Though the 'brummagem' is the artificial, it does not follow that the artificial is always brummagem, since the latter epithet is invariably used as one of reproach and contempt, whereas the other does not of itself imply demerit. What is artificial may be pleasing and beautiful; not so the paltry and 'brummagem,'—and well would it be if we never found 'brummagem' taste in combination with *genuine* materials. Pushed to the extreme as it just has been, the doctrine in question places worthiness of mere material far above worthiness of design and artistic execution, in direct opposition to the prerogative claimed for art of being able to ennoble whatever it employs as its means. It is not meanness of material so much as paltriness of design and workmanship that constitute trumperyness. In point of taste, a front coated with Roman cement or other composition may be greatly superior to one of stone; and in Italy, where, owing to the favourableness of the climate, stucco is quite as durable as some of our building stone in this country, many of the most admired things in architecture are of no more genuine material; yet no one ventures on that account to sneer at them as sham and 'brummagem.' The real objection to the use of stuccos and cements for external work here, is that we have none which will stand the weather for any length of time—none that will retain the appearance even of what it really is when in sound condition and before it begins to fall into decay. Were it not for this, stucco would be quite as legitimate a material for coating external walls as inner ones: the imposition would not be at all more, rather, perhaps, less. Even in our modern stone-work, there is something of insincerity, the walls being generally for the greater part of brick, and only faced or *veneered* with ashler; which certainly amounts to a species of deception. On the other hand, whatever be alleged against Roman cement or any fictitious material of that kind, it must be allowed that to the employment of it, we are in no little degree indebted for the greater attention now given to ornamentation where it was previously never thought of. In itself, Nash's taste was poor and trivial, nevertheless his Regent Street or Regent Park doings served to give an impulse to architectural design. Spurious in taste as they were in themselves, but for them we should probably not yet have had many things that are very many degrees better—some of them really excellent. If not what deserves to be called a taste, an appetite was created which has since been ministered to far more worthily by others.

That comparative cheapness of material and of execution also, has or did for a while encourage a great deal of exceedingly vulgar pretention, is not here attempted to be disputed; yet unless the abuse of a thing furnishes satisfactory and valid argument against the use of it altogether, the substitution of less expensive means for producing effect may very fairly be allowed to have been serviceable in helping on the advancement of architecture. No doubt a great deal of most wretchedly vulgar and tawdry "gin-palace" stuff—the demand for which is now happily abated, sprung up in consequence, almost to the discredit of architectural display altogether. Fortunately, a most convincing proof that art can employ most worthily the very same means that are frequently prostituted to the vilest taste, can be referred to, not only with perfect satisfaction and confidence, but even triumphantly, as completely upsetting the petty, querulous snarling at the making use of factitious substances and materials. Though merely executed in mastic or some other superior kind of cement, the Travellers' Club-House, Pall Mall, deservedly ranks as an architectural gem—a most tasteful and exquisitely finished up piece of design, in comparison with which many things that are in stone—and so far genuine, look mean, coarse, and vulgar.

No doubt, important public buildings and monumental edifices ought to be constructed of durable materials; but then they themselves ought to be worthy of enduring as works of architecture; which it must be confessed, is so far from being the case with some that could be named, that it would be a satisfaction rather than otherwise to be assured they were only of so-called "lath aud plaster." To the real artist, every material is of value that enables him to shape out and embody his ideas, accordingly, architects ought to be thankful for, and strive to turn to account the more frequent opportunities now afforded them. Let them show us, in stucco or cement, things worthy of being perpetuated in marble or granite. Let the public also get rid of the vulgar prejudice that estimates what are or should be productions of art, by the market value of the raw material; and nowhere does such prejudice display itself more generally and more strongly than in regard to architecture; for to say that a building is of stone, bespeaks, or is intended to bespeak, admiration for it at once.

It should be the policy of architects to uphold the value of design—of that which—provided there be any thing thing in the structures they erect that they can fairly call their own,—really belongs to themselves. Circumstances may not, indeed, always allow of much being shown in the way of design, but at any rate good taste may be manifested, if it be only negatively, by avoidiug what is contrary to it; and in general, good taste is quite as cheap, or even cheaper, than bad. Its cheapness, however, is of such kind that it is not more common in consequence of it; since though taste does not cost money, it is not to be had without being purchased by study. *Au reste*, the more cheaply taste can be administered to, and thereby become more generally diffused, so much the better for art. That is but vulgar sort of taste which bestows its admiration rather in proportion to cost and mere money value, than with regard to, or any feeling for, æsthetic merit and effect; nor is there much of the generous and amiable—very far more, in fact, of purse-proud insolence and arrogant selfishness in affecting to despise whatever is generally attainable. Those who have no other criterion of taste than vanity or expensiveness, set down what is common for being vulgar also. Hence that demand for perpetual change and new fashion, which, though it promotes industrial art, often operates injuriously with regard to good taste and its advancement. As soon as they begin to be generally adopted and brought into ordinary use, many things that were before deservedly admired for their elegance are forthwith voted to be *mauvais ton*, and scornfully discarded accordingly—and that, perhaps, for others almost the very reverse in taste.

It is utterly impossible for taste to be at one and the same time something exclusive and universal. If it ought to be the former, let us be told so, and give up striving to spread it as widely as possible, such attempt being a mischievous, if not a hopeless one. But it is altogether unreasonable to expect that, having acquired taste, people will refrain from indulging it accordiug to their means, though their means may allow them to get only semblances instead of substances—the artificial instead of the genuine—imitations instead of realities. Yet where is the great mischief of it; the imitative is not invariably to be stigmatized as the "mock," or what is better in external appearance than throughout its substance, to be sneeringly decried as "sham." It is the taste shown—the effect produced—that determines whether what is cheap in material and execution is to be regarded as trumpery or not. The effect certainly may be paltry, and if so, the thing itself may be set down for mere 'brummagem;' but that such *must* inevitably be the case admits of dispute. What is æsthetically good can by no possibility be paltry, let the material of which it is formed be ever so ordinary or cheap. Or will any one be hardy enough to maintain that plaster casts from the antique, or after the works of Flaxman, Canova, and Thorwaldsen, are shown as paltry things because the plaster itself costs only a few shillings, or perhaps only a few peuce? It may be said that in such things as plaster casts there is at any rate no deception. Well, but there are deceptions,—not that they actually impose upon anybody,—which are freely tolerated, and seem to pass for legitimate; gilt picture frames, for instance, which, though only of common wood, and well known to be so, profess by their appearance to be of quite a different material, and not only to be of metal, but of the most valuable of all metals.

It becomes a question, therefore, what is to be considered fair and legitimate, and what spurious, dishonest, and paltry imitation. Whether that species of it which cousists in applying a mere surface of the real material as a coating to an inferior one,—as is the case in veneering,—is to be

* Letter I. of this series appeared last month, but instead of being so distinguished, it was inadvertently put under the general heading of "Letters to the Club."

excepted from the general condemnation, does not appear, though it certainly may be called more fraudulent than any other. That coarse, clumsy, and 'brummagem' imitations should be condemned, is reasonable and intelligible enough, but even the excellence of some imitations, and their intrinsic beauty have been—most strange to say—urged in accusation against them, on the ground of their being, therefore, all the more deceptive. So that according to such sophistical mode of arguing the making use of any sort of artificial materials is allowable in proportion as they show themselves to be mean and spurious, and deception of this kind becomes least excusable when most successful.

Such opinion is not, indeed, stated in plain terms, because, in that case, its extravagance would be too self-evident; yet such is the conclusion which, if they be consistently followed up, some of the criticism that has of late been dealt out, inevitably leads to. The columns in the Glyptotheca at the Colosseum have been deridingly sneered at, because they are executed in Keene's cement—a species of scagliola that affords an excellent substitute for white marble, which it rivals in appearance, and is, perhaps, just as durable, in internal situations, as the other substances used by us in building. Scagliolas in imitation of coloured marbles are not expressly proscribed, but they of course must be supposed to be included under the general ban.

How the *anti-deception* doctrine is received by those who are engaged in various branches of decoration may easily be conceived, since it strikes at many manufactures and inventions that have come up of late years, and which profess to deal in downright *cheatery*. Carton-pierre, papier-maché, stamped leather in imitation of wood-carving, paper-hangings that might pass for being of velvet or damask, Wedgewood and other modern pottery, rivalling in elegance of form and design the ancient Greek frêtile vases, ought to be treated, it would seem, as little better than so many forgeries and impostures. Even terra-cotta has not escaped without strong censure, as being a most unworthy material for architectural purposes—one that may, in reality, be called ware. What then? Roof tiles and paving tiles, together with ornamental moulded and stamped bricks, may with equal justice be brought under the invidious dnnomination of *crockery*. Those who bandy about reviling nicknames after that manner, can hardly be aware that the most exquisite specimens we have of the kind—the Ionic capitals of the columns of the portico of St. Pancras church; and also, the caryatides of the same structure, are of terra-cotta, or artificial stone, hardened by fire; therefore, instead of being at all more perishable, are infinitely more durable than the real stone employed for the rest of the edifice.

Let architecture be left to avail itself freely of what materials it may; and if their legitimacy had been captiouslyquestioned, let it show that it is capable of *legitimizing* them by working them up into forms of taste and beauty. The cheaper, the more common the elegancies and innocent luxuries that throw an air of refinement over the physical wants they subserve to, the greater the spread of taste, and the greater the amount of enjoyment arising from the gratification of it. CANDIDUS.

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## ART. V.—IRON AND STEEL FOR ENGINE WORK.

THE general ambition in making cylinders is to make them sound and hard; but it is expedient also to endeavour to make them tough, so as to approach as nearly as possible to malleable iron. This may best be done by mixing in the furnace as many different kinds of iron as possible; and it may be set down as a general rule in iron-founding, that the greater the number of the kinds of iron entering into the composition of any casting, the denser and tougher it will be. The constituent atoms of different kinds of iron appear to be of different sizes, and the mixture of different kinds maintains the toughness which adds to the density and cohesion. Hot blast-iron was at one time generally believed to be weaker than cold blast, but it is now found to be the stronger of the two. The cohesive strength of unmixed iron is not in proportion to its specific gravity; aud its elasticity and power to resist shocks appear to become greater as the specific gravity becomes less. Numbers 3 and 4 are the strongest irons in most cases: iron remelted in a cupola is not so strong as when remelted in an air furnace; and when run into green sand it is not reckoned so strong as when run into dry sand or loam. The quality of the fuel, and even the state of the weather, exerts an influence upon the quality of the iron: smelting furnaces on the cold blast principle have long been known to yield better iron in winter than in summer, probably from the existence of less moisture in the air; and it would probably be found to be an improvement in iron-founding if the blast were to pass through a vessel containing muriate of lime, by which the moisture in the air would be extracted. The secret of making fine-skinned castings lies in using plenty of blackening. In loam and dry sand castings the charcoal should be mixed with thick clay water, and applied until it is an eighth of an inch thick, or more; the surface should then be very carefully smoothed or sleeked, and if the metal has been judiciously mixed, and the mould thoroughly dried, the casting is sure to be a fine one. Dry sand and loam castings should be as much as possible made in boxes; the moulds may thereby be more rapidly and more effectually dried, and better castings will be got, with a less expense.

In the malleable iron work of engines scrap iron has long been used, and considered preferable to other kinds; but if the parts are to be case-hardened, as is now the usual practice, the use of scrap iron is to be reprehended, as it is almost sure to make the parts twist in the case-hardening process. In case-hardening, iron absorbs carbon, which causes it to swell: some kinds of iron have a greater capacity for carbon than other kinds, and in case-hardening they will swell more; and any such unequal enlargement in the constituent portions of a piece of iron will cause it to change its figure. In some instances, case-hardening has caused such a twisting of the parts of an engine that they could not afterwards be fitted together. It is preferable, therefore, to make such parts as are to be case-hardened to any considerable depth of Lowmoor iron, which, being homogeneous, will absorb carbon equally, and will not twist.

Piston-rods are now very generally made of steel, and are obtained of the requisite size and quality from the rolling-mill. Steel is made almost exclusively from Dannemora iron: the bars are arranged in a furnace about 14 feet long; a layer of charcoal is spread over the bottom, then a layer of bars, and so on until about 10 tons of iron has been introduced. The top is covered with charcoal, over which is a layer of sand, and above that a layer of slush from the grindstone trough, applied wet, the object of which is entirely to exclude the air. The fire is then lighted, and in about one week the iron will have increased in weight an one hundredth and fiftieth part, and be found converted into blistered steel. These bars may then be faggotted and tilted, so as to form steel articles of any size. In the operation of case-hardening the same process is carried on as in converting iron into steel, but it is only continued for such a time as to enable the charcoal to penetrate to a moderate depth. In our judgment, all the malleable iron parts of a marine steam engine should be case-hardened, as they cannot then be so easily defaced by hammer marks, or otherwise, and will be much less liable to rust. The more unwieldly portions may be case-hardened by prussiate of potash, a salt made from animal substances, composed of two atoms of carbon and one of nitrogen, and which operates on the same principle as in the case of case-hardening by means of charcoal. The iron is heated in the fire to a dull red heat, and the salt is either sprinkled upon it or rubbed on in the lump, or the iron is rolled in the salt in powder: the iron is then returned to the fire for a few minutes, and immersed in water. By some persons the salt is supposed to act unequally, as if there were greasy spots upon the iron which the salt refused to touch, and the effect under any circumstances is exceedingly superficial; nevertheless, upon all parts not exposed to wear a sufficient coating of steel may be obtained by this process. The most common plan of case-hardening consists in inserting the articles among horn or leather cuttings, bone dust, or animal charcoal, in an iron box provided with a tight lid, which is then put into a furnace, and kept hot for a period answerable to the depth of steel required. In some cases the plan pursued by the gunsmiths may be employed with convenience. The article is inserted in a sheet-iron case, amid bone dust, often not burned; the lid of the box is tied on with wire, and the joint luted with clay, and the box is heated to redness as quickly as possible, and kept half an hour at an uniform heat. Its contents are then suddenly immerged in cold water. The carbonaceous lining in the inside of old retorts is sometimes used in case-hardening with good effect.

Steel is hardened by heating and cooling it suddenly, and softened by heating and cooling it slowly. A thin blade of steel, if heated, and placed between the cold hammer and the anvil, will become extremely hard; whereas a thick piece of steel would not be made hard by such a mode of treatment. Mercury has been proposed, instead of water, for hardening steel, but its use is not attended with sensible advantage. Salt and water is also used, but the articles immersed in it are liable to rust, unless afterwards steeped in lime-water. Water which has been long used for tempering is supposed to be preferable to fresh water, and if the steel is harsh the chill is taken off the water. In the case of thin edge tools the water is sometimes covered with a film of oil, but it is a question whether plain water is not preferable. The file makers medicate the water they use for tempering, and the method of doing so forms one of the secrets of the trade; but it appears probable that a little white arsenic is the chief addition they make. A common practice with some steel articles is to make them in the first instance as hard as possible, and then to soften them somewhat, or let them down, as it is called, by heating them to a certain temperature, which is indicated by the colour they assume. A pale straw colour, which is indicative of a temperature of from 430 deg. to 450 deg., is the colour proper to tools for metal; a dark straw colour, 470 deg. to 490 deg., is that suitable for tools for wood and for screw taps; a brown yellow, verging to a light purple, 500 deg. to 530 deg., is the colour suitable for hatchets and saws; and a dark blue, 550 deg. to 600 deg., is the colour for springs. Steel dies may be tempered by heating them to the colour of sealing wax, plunging them into naphtha heated to 200 deg., and so soon as ebullition ceases, plunging them into cold water. It appears to be the prevailing opinion among experienced mechanists, that for the great majority of articles requiring to be tempered, plain cold water is the best agent, but that for small elastic works, oil is preferable. For letting down large tools, a red hot muffle is a convenient instrument, as is used in the Bank of England. Steel articles may be most effectually softened by exposing them to a high heat, imbedded in a mixture of charcoal and chalk. Steel that has been spoiled by overheating may be recovered by heating and quenching in water four or five times, carrying each to a somewhat less degree than the first excess, and finally the steel must be well hammered at a red heat, continuing the hammering until the steel is nearly cold.

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## Art. VI.—ENGINES APPLIED DIRECT TO THE SCREW.

It requires but little penetration to foresee that the present species of marine engine must be given up if the screw propeller gains a general introduction, as it appears destined to do; for the engine will in that case be coupled immediately to the screw shaft, which, as it requires to revolve much more quickly than a paddle shaft, involves greatly increased speed of piston. Small engines with the pistons moving at a quick speed will exert the same power as large engines moving with a slow speed, the boilers and steam ports and passages being the same in both cases, and small engines, by being applied to the screw shaft direct, may thus be made to do the work of large ones. This is a manifest advantage to steam navigation, as a vessel may be constructed with very large power without being inconveniently burdened with the weight of the engines, and it is also an advantage to the makers of engines, who will thus be enabled to produce a given power at a less cost. The only impediment to the general introduction of this system lies in the difficulty of driving the air pump at a high speed without causing the valves to strike so hard as to wear themselves out very quickly. The difficulty may, however, it appears to us, be met, as suggested in our January number, by making the air pump piston without valves, and opening and shutting the foot valve passage by means of a slide valve, the motion for working which is derived from the eccentric rod. The delivery valve must still be opened by the pressure of water in the pump, but it may be made to consist of a piston valve with skewed ports, and it may be closed, or the piston be brought opposite to the ports, by means of a pendulum weight at the end of a lever moving outside. Most of the engines at present in course of construction for direct application to the screw, as we mentioned on a former occasion, are made with four cylinders lying horizontally with two cranks upon the screw shaft to which the connecting rods are attached, the connecting rods being joined to the top of the piston rods, as in the *Gorgon* or locomotive construction. Oscillating engines laid at an angle of 45°, and joined to a single crank on the shaft, have in some cases been employed, and we think this arrangement is upon the whole the preferable one. The air pump may be made double acting, and may be worked from the same crank pin to which the piston rods are attached, the pin, however, being made eccentric in the part to which the air pump rod is attached in order to give the pump a shorter stroke than the piston. The crank and crank pin will, if this arrangement be adopted, be stronger if made in the same piece, and the neck of the shaft, where the crank overhangs, must be made stronger than usual. If the air pump be made double acting, as appears to be the preferable practice, its diameter may be very small, but the foot and delivery valve passages must be larger than usual in proportion to the size of the pump. If a piston valve be adopted for the delivery valve, it will be expedient to balance the valve by means of a counter-weight as is done in case of the steam valve, adding then a pendulum or a short crank pulled into the vertical position by a rod loaded with a weight, the end of the rod being suitably guided by a swivelling eye, in order to bring back the valve or retain the piston opposite the ports until the pressure comes on. It is clear that, if this arrangement be adopted, the thrust of the shaft forwards, which in the case of the *Rattler* screw steamer is equivalent to a weight of four tons, cannot be sustained by the end of the shaft, and the best arrangement appears to be to receive the thrust upon a collar on the shaft which works within an oil cylinder, oil being forced continually by a small pump worked by the engine between the end of the oil cylinder and the collar, until the collar is forced back with a pressure equal to that of the forward thrust. It is not expedient, however, to trust to the oil alone, and therefore between the collar and the bottom of the oil cylinder, and also between the collar and the top of the oil cylinder, so as to give security for backing, rollers carried by rings should be interposed, as in the case of the rollers of a swivel bridge or railway turn-table. These rollers should be as numerous as can be conveniently applied: they should each touch only in one point, should be made narrow, and several of these narrow rollers should be set upon the same spindle so as to increase the quantity of the bearing surface. The collar and ends of the oil cylinder should consist of plates of hardened steel, and the rollers should also be of hardened steel, and be all made of exactly the same diameter. The oil cylinder would have to be supplied with a safety valve on each side of the collar, so that any surplus oil sent in by the pump would be able to escape into a small tank out of which the pump would draw. By these expedients it appears clear to us that the thrust of the screw may be effectually and satisfactorily counteracted. It appears expedient to tooth out the eye of the collar and to make it of sufficient length to serve as a coupling box, the end of the shaft, proceeding from the screw to the collar, being similarly toothed and fixed fast into the collar; while the end of the shaft, proceeding from the collar to the engine, is toothed in the same fashion, but so fitted as to slide endways in the collar. By this arrangement, should the oil cylinder yield slightly, or the roller wear, the engine framing will still be preserved from the forward strain; the only effect of such accidents being to make the engine-shaft slip somewhat further into the collar. The edge of the collar would be furnished with cupped leathers upon each side, of the same description as those used for the rams of hydraulic presses. The improvement of the species of engine that is adapted for direct application to the screw is one of the most important objects that can engage the attention of the marine engineer; for the ultimate universality of screw propulsion appears to be the most probable conjecture at the present time; and if the screw supersedes the paddle, the best form of direct action engine, applicable to the screw, will secure the most extended patronage. Unless a very perfect rotatory be devised, the oscillating engine coupled direct to the crank, in the manner we have described, will probably maintain the supremacy, or perhaps some improved form of the trunk engine may be employed with advantage. There appears to be considerable doubts among many engineers as to the success of engines coupled direct to the screw from the shock attending the rapid motion of large masses of matter, but in these doubts we cannot participate, as they appear to us to have been already resolved by the successful action of the locomotives. Except in the action of the air pumps, there is nothing new or untested in the speed with which engines coupled direct to the screw require to work; and, although these marine engines are heavier than locomotive engines, the effect is only equivalent to that of a few locomotive engines acting in concert.

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## Art. VII.—RAILWAY TURN-TABLES.

The ordinary operations of railways would be very seriously disturbed if there was no ready means of removing engines and carriages from one line to another. The system of switches effects this change to some extent, but in the case of a large number of carriages being congregated at a terminus it would occasion great inconvenience if the whole had to be backed to some distance from the station in order to allow a few of the rearmost to be transferred to another line. Besides, the engines require to be turned round for the return journey, and turn-tables have been introduced to facilitate these operations. Several varieties of turn-tables have been used, one of the rudest of which is a revolving table with wheels attached to it. Sometimes they have been made with the wheels running in bushes secured to the ground, and some have been made in the form of a circular table, turning upon a central pillar upon which it fits with a deep collar after the fashion of a crane. By this arrangement the weight, if unequally distributed upon the table, acts with great power upon the central pillar. To obviate

Fig. 2.

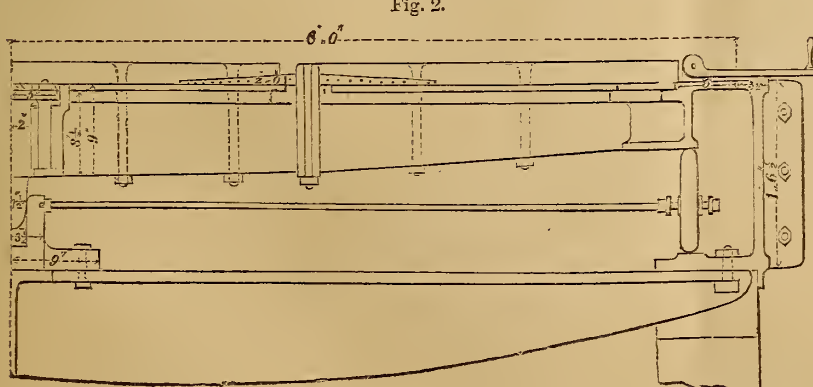


Fig. 3.

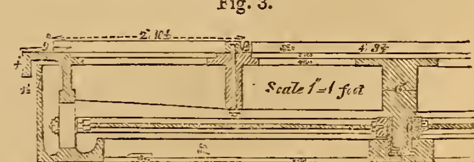


Fig. 4.

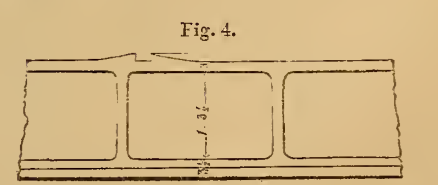
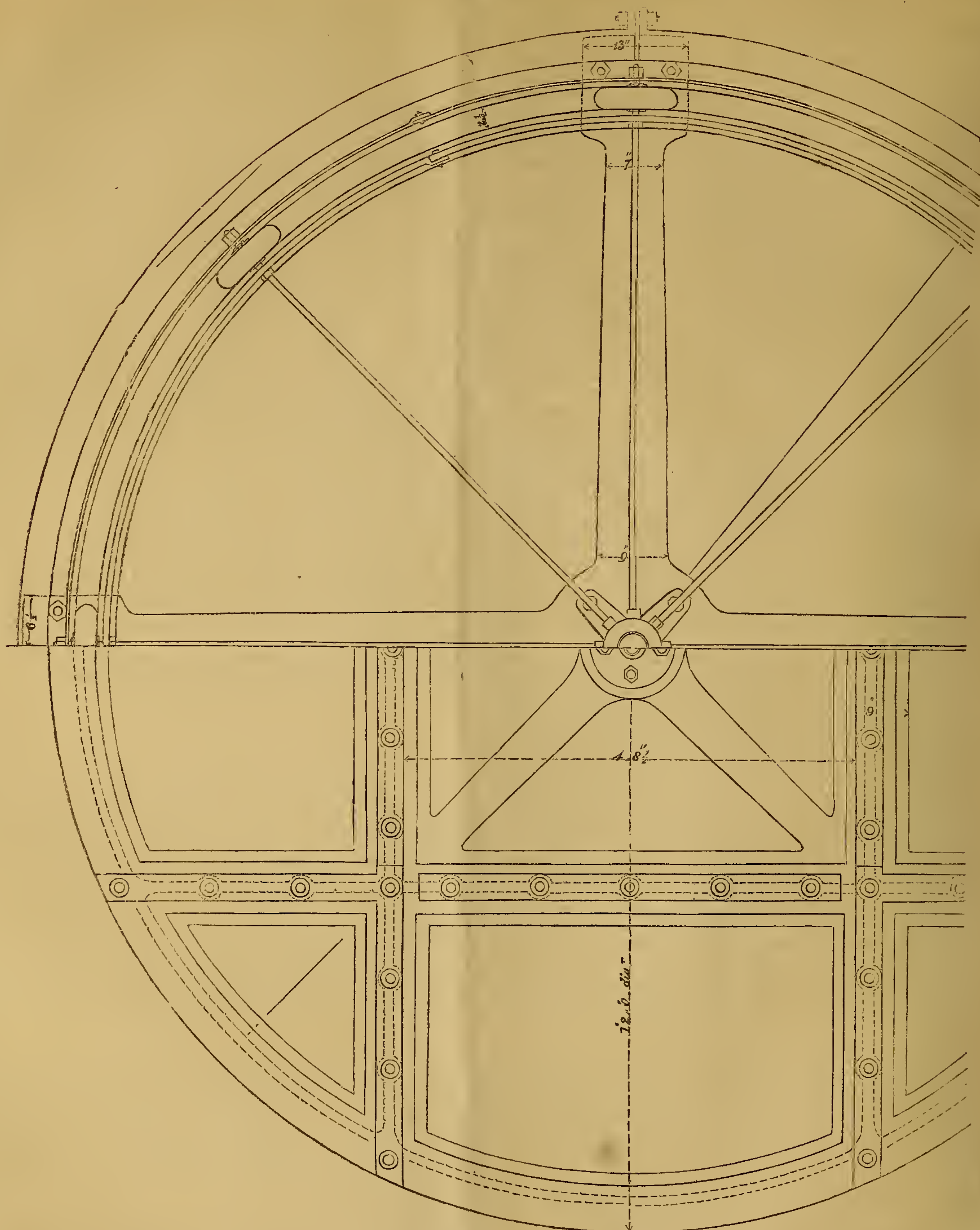


Figure 1.



this objection some wheels are fixed to the foundation at intervals, upon which the platform rests when there is any considerable deflcetion, and the violence of the shock which a carriage running suddenly upon it would otherwise occasion is thus in some measure obviated. In Ellis' turn-table there is a further refinement introduced; the whole platform when not being swivelled is lowered down upon its solid foundation, forming as it were part of the permanent way, and is then exempt from jolting, and is not liable to injury from the shocks of passing trains. To render the apparatus more useful, it is made convertible into a weighing machine, but we have never known any good to come of the attempts to unite in one piece of machinery the independent functions of many, and the result has generally been that the machine has either fulfilled its multifarious offices inefficiently, or at an undue cost for construction and maintenance. The ordinary turn-table, and that which we think the most efficient, as well as simple, consists of a table running upon pullies or rollers which are neither attached to the foundation nor to the table, but run in an independent frame-work. The motion of this turn-table is very easy, and as there is no strain upon the axles of the rollers there is little liability to wear or break. The accompanying figures represent one of these turn-tables. Fig. 1. is a plan, one half the table being shown without the moving platform and the other with it. Fig. 2. is a vertical section through the centre of the machine. Fig. 3. is a section of Bramah's variety of turn-tables, and Fig. 4. is a view of the outer part of the foundation plate. One difference between Fig. 2. and Fig. 3. lies in the form of the friction rollers, which, in Bramah's are made conical instead of being rounded. The machine consists of a strong bed-plate of cast iron strengthened by means of brackets. The centre piece of the table is supported on a plate, in some cases fixed to the masonry, in others to the central plate of the circle, or to an internal projecting flange from the shell of the machine.

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## Art. VIII.—NOTES OF THE MONTH.

*Ruthven's Method of Propelling.*—Mr. Ruthven, of Edinburgh, is at present making experiments with a boat forty feet long, propelled by means of a stream of water forced out of the stern by a fan-wheel, and he is said to have realized a speed of eight miles an hour. The local papers, as is usual in such cases, laud the scheme as certain to effect a revolution in the art of steam navigation; for such logicians appear to regard those schemes as certain of success, which have not been tested by experience. We cannot say that we participate largely in the deductions of this sanguine paradox, and we have no great hopes of Mr. Ruthven's present project. There is no important feature of novelty about it, for the plan of propelling vessels by forcing water out at the stern has often been tried by other persons, never with any great success; and although it appears to us such a plan of propulsion might be made effectual, we do not think it can be made so convenient and eligible as the mode at present known and practised. To obtain the full effect from the effluent water it must not be discharged with a much higher speed than that of the ship, and the calculation is an easy one to determine what the diameter of a column of water must be, flowing with a given velocity, to possess the mechanical virtue of an engine of a given power. In all ordinary cases it will be found that the diameter of the column will be such as to require a pipe of inconvenient size. The diameter of the column, indeed, will be nearly the same as that of the screw propeller proper for the same power. The diameter of the screw propeller of the *Rattler* is ten feet, and what vessel would like to have a pipe ten feet diameter through the bottom?

*Imperfections of Military Science.*—Military science is in arrear of the age, and if battles must be fought, the military authorities must either mend their hand, or the civil and mechanical engineers must be called in to do the work. The arts of destruction are still in a most primitive state, yet there appears to be no disposition to make them more effectual; and we suppose thousands of our soldiers must be sacrificed by the adoption, by enemies, of the expedients we neglect to use, before their introduction can be sanctioned by our authorities. This supiness would be commendable enough if it sprang from a love of peace; but it has its origin in no such feelings; and it only serves to make the preservation of peace more difficult, by increasing the confidence of those who would not hesitate, with such chances in their favour, to disturb it. It appears to us, therefore, that one of the best guarantees of peace lies in the power we could bring to act against our opponents; for it can hardly be doubted that England is more sincerely desirous of peace than most nations; and the more her influence is increased, the greater will become the chance of its preservation. It is not by standing armies, however, this influence is to be recruited, but by the perfection of her military skill, and the largeness of her resources; and the opinion seems to be fast gaining ground, that in military skill we are at present extremely deficient. Will steam be brought to act upon the field of battle? We think it extremely probable; and where is the column or square that could withstand the charge of a troop of locomotives? Rockets do not yet appear to have acquired the position they will one day obtain. Their projectile force may be made as great as that of cannon balls, so that in campaigns, cannon balls may, in effect, be fired without the cannon. Then why are not malleable iron cannon used for locomotive purposes instead of the cumbrous cast-iron guns at present in use? Or what is to prevent rocket carriages from being used, that a rocket would propel in any required direction, whether up hill or down, and which might carry enough gunpowder to destroy a regiment by a single explosion? These are indeed terrible results; but if war occurs again it is to be hoped that it will be made so terrible by the resources of science that the bravest will shudder at its perils, and join in the aspiration that some more reasonable means may be adopted for settling the disputes of nations.

*The Earl of Dundonald's Engines in the Janus.*—The Admiralty, it is said, are getting impatient at the expense and delay occasioned by the unsuccessful trials of the *Janus*, and it is believed to be now in contemplation to remove the Earl of Dundonald's machinery and introduce engines of the common description. Such a determination, however, appears to us to be altogether unwarranted, for if it was wise to try the Earl of Dundonald's engine at all, it is still more wise to try it fairly, and it appears very clear from the fractures, leakages, and numerous imperfections of detail, that the principle of the engine has been in no wise tested. For these practical imperfections the Earl of Dundonald should not be held responsible, for he does not pretend to be a practical engineer; and the existence of such faults only proves that the practical engineers in whom the Admiralty have confided are either very supine or very unskilful. If Lord Dundonald's engine be tried with the same advantages of construction as ordinary engines—if the various parts be made tight and of adequate strength, which can be done by competent persons, and if after this the result is not satisfactory, by all means let the engine be discarded; but do not try a new invention in so imperfect a way as to make its success impossible ,and then visit upon the plan the reproach of your imperfect execution. We do not mean by these remarks to say anything in commendation of the Earl of Dundonald's engine, further than we think the plan an ingenious one, and believe such an engine capable of being made to work satisfactorily. That it will be found preferable to the common engine, we by no means maintain, but it is a disgrace to the Admiralty that they cannot try a simple experiment of this kind without being baffled by imperfections in the details of construction which ordinary skill could overcome. The right plan would be to place the engine in the hands of some practical man or other to cure its practical defects, and if he could not do it, then some other person should be tried. If this were done, we should soon have this ill-fated engine working efficiently, and the Admiralty would also know to what practical engineer difficult tasks might be confided for the future.

*The Great Britain.*—This vessel is at present undergoing various alterations in her machinery, under the direction of Mr. Field, the eminent engineer, and the result will probably be that her rate of speed will be considerably amended. From the first she has been deficient in steam, and her machinery has been imperfect in many ways, for which imperfection Mr. Brunel is, we suppose, responsible. Mr. Brunel should be careful how he meddles with anything that has to work. A few eccentricities in a bridge or railway do not so readily tell, but an engine is an eloquent thing, and, in the present instance, it does not say anything in Mr. Brunel's commendation. Such a daring, and at the same time such an inartificial piece of engine work as the Great Britain's engines we never before saw; and though the ignorant may stare, the proficient will conclude that they are the production of a person of no fear and small proficiency.

*The late Storms in Scotland.*—The following interesting details regarding the hurricane have been supplied by Professor Nichol, of the Glasgow Observatory:—"I have now had experience of a good many storms here; but certainly none of them at all equalled in fury the gale of this morning. The devastation caused by it in the district over which it has passed must have been quite unprecedented. The facts, as observed at this observatory, are the following:—About 1 o'clock on Tuesday afternoon the barometer began to fall. It was then 29·156 (corrected for temperature), and it fell very gradually, by a small quantity each hour, so that at midnight it stood at 28·980. The wind was not high as yet. Towards the evening it blew fresh, but nothing more. The subsequent occurrences are too important to be passed over with only a general notice, and I therefore give them in a table:—

| 4th March. Wind. | Height of Barometer. | Force of Wind. | Direction of Wind. |
|---|---|---|---|
| 1 A.M. | 28·944 | 6·— | S. |
| 2 — | —·855 | 10·— | S. |
| 3 — | —·779 | 12·— | S. |
| 4 — | —·705 | 23·— | S. |
| 5 — | —·628 | 28·— | S. |
| 6 — | —·566 | 29·— | S. |
| 7 — | —·546 | 30·— | S. |
| 8 — | —·526 | 37·— | S. slightly W. |
| 9 — | —·480 | 45·— | S. by W. |
| 10 — | —·549 | — | S. by W. |
| 11 — | —·680 | — | S. W. |
| 12 — | —·793 | — | S. W. |

The temperature at 8 in the morning was 47 degrees 12 seconds of Fahrenheit, at 9 it was 45 degrees 5 seconds, and at 10, 46 degrees ·04 seconds.

The force of the wind in the foregoing table is expressed in pressure of pounds weight on a square foot. The record of force ceases at 9 o'clock, as the tempest then broke the part of the anemometer which indicates it. I was too much engaged in efforts having regard to the safety of the house to take particular note of minute changes: but I have reason to believe that the storm at that time was near its *maximum*. One peculiarity very much struck me. In general these hurricanes come in mere gusts of great waves. This one did so too; but I have never known a storm in which the power of the gust was so persistent; the pencil of the anemometer remaining at its full height for a very considerable space of time."

*Boiler Explosion.*—A boiler has recently exploded at Halifax in the foundry of Mr. Bethel Anson. Previous to setting the fan in motion to blow the furnace, Anson was employed in some way about the engine, and a man named Taylor was going to him on business at the moment the explosion took place, which tore the engine boiler from its seat, and drove it completely through an adjoining house across the next street, and against the house opposite. A woman, who was washing in a cellar kitchen, was seriously cut with the splinters of stones. Several children were hurt, one boy seriously. Taylor was found under a heap of rubbish quite dead, and Anson only survived half an hour. An inquest was held on the bodies, when it appeared that the explosion arose from a deficiency of water in the boiler. There was evidence of its being nearly red-hot immediately after the accident. There also appeared to have been great carelessness on the part of Anson, who had the management of the engine, as he had worked the boiler without water-gauge or feed-pump for a considerable time, and very frequently at a high and dangerous pressure. The verdict was—"That Anson and Taylor were killed by the explosion of a steam-boiler caused by a want of water." It seems strange that the proprietor should have acted as engine-keeper, and stranger still that he should have been so reckless. The absence of a water gauge, either in the shape of a glass gauge or of gauge-cocks is a serious defect, though the absence of a feed pump might not be very material if the boiler, as is sometimes the case, was supplied with water from the pipes of a water company or a cistern. It seems certain, however, that in whatever way the feed was supplied, there had been too little water in the boiler, and it is not improbable that the explosion was occasioned by the sudden introduction of cold water upon the heated plates, which was instantaneously converted into steam of excessive pressure. This seems borne out by the circumstance of Anson being engaged about the boiler at the time of the explosion, although it may also be accounted for by supposing that the steam had simply been allowed to accumulate in readiness for the starting of the engines before which the limit of the resistance of the boiler was reached, and the temerity of the attendant fearfully punished. We can never sufficiently urge the propriety of putting engines and boilers under the care of competent persons; we are aware that this is almost always neglected, and we have known a large factory with two engines, one of which was confided to an ignorant drunken labourer, and the other to the youngest apprentice of one of the departments. It is true that they have never succeeded in blowing up their boilers, but we apprehend that they are greatly indebted to fortune for the astonishing exemption from such catastrophes.

*Dwellings of the Poor.*—It is very gratifying to observe the growing interest which is taken in measures calculated for the improvement of the condition of the poorer classes of the population. Societies have been formed for the purpose of furnishing them with good dwellings, at a price as low as they at present pay for greatly inferior accommodation. One of these societies has completed some "model buildings" in the neighbourhood of Gray's Inn Road, which we have inspected with much satisfaction. The houses are two stories high, some comprising both floors with two apartments on each, and in others the ground and first floors are let separately. The two floors are let together at six shillings a week, and the single floors at three shillings and sixpence, the entrances being independent. One room is intended for a bed room, and the other for a sitting room and kitchen, and is furnished with an iron hearth range, containing an oven with a damper attached on one side of the fire, and a cistern of hot water, with a cock, on the other side. Opening into the kitchen is a scullery, with a slate trough supplied with water from a pipe and cock. At one end of this scullery a door opens into a water closet. All the rooms are ventilated by apertures, communicating with the external air, into which perforated plates are fitted, and the ingress of cold air may be regulated or completely prevented by a sliding plate. A flap valve is placed in the chimney, near the ceiling, which is counterpoised by a loaded arm, so that a very slight pressure upon the valve will open it, and permit the escape of heated and vitiated air from the apartment. One house is set apart for widows, who are to occupy single rooms ranged on either side of a long passage, both on the ground floor and upper floor. Water closets, and troughs supplied with water from a pipe, are placed at the ends of these galleries for common use. Behind the house there is a wash-house containing a boiler and wooden washing trough, also well supplied with water from a pipe; and a space is provided with poles for drying clothes. The stairs and passages of the 'widows' house' are lighted with gas, and the cost of each room, with all these attendant advantages, is one shilling and sixpence per week. The rents have been made so moderate that the Society is obliged to guard against loss by requiring security for the payment; and they have already let about one half of the houses. We think this is a judicious precaution, especially in the early stages of their proceedings, inasmuch as any pecuniary loss, or any injury to the houses, or indifference to the advantages they afford, which tenants of a very low order might have been chargeable with, would have probably led to a hasty decision against the infant scheme.

*Paddle-Box Boats.*—The late loss of the Great Liverpool has again raised the question whether paddle-box boats should not be fitted to every sea going steamer, and it appears very desirable that the question should now be fully discussed and set at rest. Whatever difference of opinion may prevail as to the merits of the paddle-box boats, it is we believe on all hands agreed that *some* plan should be adopted, whereby an adequate provision of large and sea-worthy boats might be secured for the passengers and crew in case of shipwreck or fire, and the question is therefore narrowed into the consideration whether the paddle-box is the place where such boats might be most conveniently deposited. It appears to us that no general rule can be laid down upon this point, yet, in the majority of steam vessels a preferable situation to the top of the paddle-box might we conceive be selected. The top of the paddle-box is far from the centre of gravity of the ship, and the depositure of any considerable weight in that situation will be more likely to make the vessel roll than if placed lower down, while the effect of the rolling in the act of launching the boat will at the same time be more inconvenient. There is some danger, moreover, when the boat is lowered into the water that it will be caught by the paddle floats or wing-wales during the roll of the ship and be swamped, or the same disaster might arise from an accidental movement of the wheels, caused either by the admission of steam to the engines, or by the action of the sea upon the paddles. The wheels will sometimes be moved in troubled water in spite of the engines, and although they might be lashed to prevent such casualties, yet the necessity for such an operation in a time of danger is itself an objection; and to lash the wheels might place the vessel in a new jeopardy, by hindering her from making a turn ahead or astern, which might be demanded by the exigencies of the occasion. These objections are neither new nor mysterious; we stated them three years ago, when the question of paddle-box boats first began to attract attention, and though it is clear that they rise to no higher importance than mere hazards which may often be escaped from the absence of the concurring circumstances we have supposed, yet we cannot see on what ground such risks should be left out of the account in an inquiry aspiring to determine the most eligible situation in which life boats may be carried. The arrangement we suggested three years ago, of placing the life boats on the wing-wales, with their mouths turned against the gunwale, and their bottoms, which should be made flat, forming part of the ship's sides, we are still disposed to regard as the most judicious for the generality of steam vessels. These boats might be made of sheet iron zinked, divided by water tight bulkheads, and with the seats formed into air tanks, so that they could not sink even though filled with water; they might be made of a large size, and the swivelling of the davits in the operation of launching would bring the boats to the gangways, and carry them clear of the paddle wheels.

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## Art. X.—NOVELTIES IN ART AND SCIENCE.

*Miracles of Electro-Galvanism.* — The *Observateur Francais*, of course with a due degree of scepticism, publishes the following communication from a corresponding member of the academy of Brussels.

M. Eseltze has made some experiments (which he terms *Anthroposcopic*,) by means of an electro-galvanic light derived from a Bunsen pile, and directed through a round opening in a window-shutter into a darkened chamber, furnished with powerful reflectors. By the aid of this light he has distinctly perceived the veins and arteries in the human subject, has detected the action of the nerves, and with the microscope has observed the transmission of the blood from the arterial into the venous branches. Directed upon the heart, the light is said to have displayed the systole and diastole movements as clearly as if seen in a glass case. The experimenter has recognised, counted, and made drawings of many cavities in the chest of a consumptive patient, and has observed some of the processes of digestion. He has found that rubbing the skin with olive oil greatly increases its transparency.

One fact M. Eseltze remarks upon as especially strange; it is that the bones cast no shadow. The light appears to envelope them as water envelopes the piles of the bridge; the ribs themselves do not obstruct the view any more than the cartilages. The muscular mass is of a rose tint, and permits the recognition of the liver, the biliary duct, and the spleen, which latter organ appears to be nothing more than a diverticulum of the blood, since the subject can fill it at will by a simple thoracic effort, a little sustained, or by placing a ligature on one of the limbs. M. Eseltze professes also to have discovered lumbrici in the colon of his subjects, to have distinctly seen a fœtus of two months old, exhibiting a vibratory movement in the liquor amnii; to have examined minutely the lacteal apparatus in the breast of the mother, and to have observed an engorged gland becoming cancerous.

Finally, the experimenter declares, that he could perceive in each of the nasal fossæ of a snuff-taker, whose pronunciation is nasal, an accumulation of snuff; and in the lymphatic vessels of the same individual, globules which he believes to be pure quicksilver.

*Indian Cobalt.*—A new field of cobalt has been discovered in the East Indies, in the mountainous country of Rajpootanah,—a district already celebrated for its mineral wealth, and principally for its coppers in the state of sulphate, and also for its alums. It is in one of the copper-mines that this cobalt is found. It is accompanied by iron pyrites, highly magnetic, and easily separated from it by a loadstone of moderate power. The remainder of the mineral consists wholly of pyrites of cobalt, of the specific weight of 5·45 and composition following:—cobalt 64·64, sulphur 35·36. The Indian jewellers use it advantageously for colouring gold with a rose tint of great delicacy.

*Steam Hammer.*—A trial of Mr. James Nasmyth's steam hammer has just been made in Chatham dock-yard. In the course of the experiments, part of the shank of an anchor, weighing about 30 cwt., was heated to a welding heat, and beaten out by the hammer to a rod of about four inches in diameter in a finished state. Mr. Nasmyth, we understand, has orders to provide a patent steam hammer for each of Her Majesty's dock-yards. Most of the old anchors being charcoal iron, a large quantity of superior iron will be procured from them. In beating out iron for conversion, the blows are so powerful that all spurious materials are driven from the iron, and the whole mass perfectly consolidated. This result was shown by the four-inch rod being cut into various lengths, when it was seen to be solid metal, whilst the part of the shank that had not been under the hammer showed nearly every bar and rod with which it had been faggotted. In large hammers on Mr. Nasmyth's plan, there is, we understand, some difficulty in getting the piston and other parts of the engine to withstand the jarring to which they are subjected. It will, perhaps, be found the best way in such cases to put the cylinder at the one end, and the hammer at the other end of a working beam, as was long ago proposed by Mr. Watt.

*The Double Comet.* — The Paris correspondent of the *Augsburg Gazette* gives the following account of a recent sitting of the French Academy of Sciences:—" Fresh communications were made respecting the double comet. According to earlier advices the celestial was seen on the 20th of January in a single, and on the 28th in a double form, and it must therefore be supposed that it broke asunder in the interval! It is now represented that it was seen on the 12th of January, in Washington, and on the 15th in Konigsberg, as a double comet, and that accordingly the division must have taken place still earlier. On the 12th of February, both the *nuclei*, according to a rough calculation, were about 2,000 degrees apart from each other, and the observations made seem to intimate that the distance was increasing more and more. A second peculiarity is now added to this double form. Both *nuclei* stand so that a line can be drawn through them almost perpendicular to the tail, and therefore a northern and southern *nucleus* exists. At first the southern *nucleus* was far brighter than the other, to discern which a far greater magnifying power was required; but now the reverse is the case, and the northern *nucleus* shines far brighter than the southern. What we are to gather from this matter nobody knows. I pity the astronomers! Comets were always awkward customers which gave them a great deal of trouble. This very Biela comet, however, was one of the most well-bred of the tail-stars. It went round the sun decently and orderly in two years and a quarter, and only disturbed itself so far as to prevent too close a reckoning; and now, when it has already wandered for a length of time in the prescribed path of a peaceful heavenly body, it suddenly gives way, perhaps, from inward fermentation, to the most lamentable schisms and most fearful divisions. It must be deemed a real piece of good luck that the mass of such a comet is too small to exercise any considerable influence over its neighbours; there still remains, however, the annoying example. At the last sitting of the Academy it was affirmed that old Chinese books, still extant, actually predicted similar casualties in the starry heavens; but this antiquated consolation appears to me, at all events, insufficient, even if it proves convincingly the historical ground, and the legitimate correctness of the thing."

*New Omnibus.*—A new omnibus has been invented by Messrs. Hunnyburn and Vender, which appears to us to be a considerable improvement upon the kind at present in use. By cranking the axle, the floor of the omnibus is brought so near the ground that the steps may be dispensed with, the passenger being able to step from the street to the floor direct. A second seat is placed behind the driver's seat for the accommodation of outside passengers, and by encroaching a little upon the head room in that part which, however, is no inconvenience to the persons seated on the cross-seat in the inside—the second outside seat is obtained without increasing the length of the vehicle. On the interior of the roof two brass poles run from one end to the other, so as to enable passengers more easily to get in or out when the vehicle is full. The whole of the improvements are sound and practical, and the design appears to be the production of persons well acquainted with the subject.

*Fraudulent Tricks of the Electrical Girl.*—The miracles ascribed to Angélique Cottin, the electrical girl, which have lately made some noise in Paris, and which were to some extent attested by M. Arago, are now discovered to have been frauds, practised upon the credulity of the *savans*, and M. Arago has admitted the deception. At a late meeting of the academy of sciences, he read a note on the part of the commission of which he was a member, declaring the matter to be unworthy of a report, but conveying the result in this less ceremonious form. M. Arago is blamed loudly by many persons for his credulity, though as we think without any sufficient cause, for who can measure the powers of electrical agencies, or can say that any physical effect is not accomplishable by them. Of course, the performances of such adventurers as the electrical girl are to be viewed with great circumspection; and, it appears, that instead of the chair on which she sat being forcibly projected back by electricity, it was accomplished by her heels. Yet there was obviously nothing absurd or impossible in such phenomena; and it is no derogation from a philosopher's dignity to descend to the investigation of reputed facts in a department of knowledge where he has no clear principles wherewith to test their value. The worst credulity is that which believes in impossibilities at every step, and holds everything to be a snare and delusion which does not harmonize with existing theories, however precarious their basis.

*A Patent Voice of Thunder.*—'A voice of thunder' has ceased to be a metaphor. The Paris papers speak in terms of commendation of a language, which is to be spoken by cannon, invented by M. Sudre, which, it is stated, may be of material use in time of war, and on which the inventor has been experimenting successfully before the Duke of Nemours at Vincennes. It is clear that a language may be constructed of sound signals as well as sight signals, and sound signals are available by night, and do not require attention to be perpetually directed to their observation. It is worth consideration whether a cannon telegraph might not be established in our own army with advantage.

*Gutta Percha.*—This substance, the introduction of which into this country we noticed some months ago, appears likely to find a number of valuable applications in the arts, and several patents have been taken out for its new uses and modes of preparation. Gutta Percha is composed chiefly of carbon and hydrogen; it is a resin-like substance, similar in appearance to mastic, inflammable, soluble in essential oils and naphtha, and capable of being softened by hot water or steam, and kneaded or moulded into any form. It is free from stickiness, and may be manufactured into glass and picture frames, mosaics, buttons, studs, counters, labels, balls, bracelets, armlets, garters, rings, and other circular articles, reins, bridles, belts, bands, &c. Or it may be used for any purpose for which an elastic air and waterproof substance, unaffected by ordinary degrees of heat, is suitable, as, for example, as a material in which to produce pictures either in relief or intaglio; or as a covering for beds, couches, and cushions; or a material for billiard-table cushions; or a substitute for metallic springs; or as a bearing for railway rails and chairs, or parts of machinery; or as a material for atmospheric railway and other valves. It may be used also in the same manner as Indian rubber for making water-proof fabrics, by cementing woven fabrics together; or there may be added to the gutta percha, while in the kneading-machine, paper-pulp, wood-dust, leather-dust, hair, bristles, oakum, &c., and compound fabrics will be thus produced very suitable for paving, roofing, sheathing, and other purposes. In solution, gutta percha forms a useful varnish: it may be applied to ropes to make them waterproof, to silks to stiffen them, and to Indian-rubber articles to remove their stickiness and peculiar odour. The most valuable application would probably be to the formation of artificial leather shoes, but we have not yet heard of that having been proposed.

*Failure of Potato Seeds to produce sound Potatoes.*—Dr. Lindley, at a late meeting of the Horticultural Society, read two commuuications, and stated the results of experiments made on the propagation of potatoes from seeds, which had been suggested for the purpose of producing a more healthy future source of supply, from the probable present exhaustion of the stock. Such anticipations, it was thought, might lead to disappointment, and the experience of one case in particular shewed that little reliance could be placed upon it, as the seeds of the season 1844, before the disease had appeared, produced eighty potatoes which were very much diseased, although the haulms were not in the first case affected. The evidence on the subject was, however, very conflicting.

*Avanturine Glass.*—We gave in number X of the *Artizan* an analysis of this substance, which is a glass studded with metallic spangles, the fabrication of which hitherto has remained a secret with the glass-blowers of Venice, and fine specimens are rare, and fetch a high price. The process, after numerous experiments, adopted by MM. Fremy and Clemandot, who have recently communicated their method of procedure to the French Academy, gives results which promise that avanturine may be made in all glasshouses. After having unsuccessfully tried the action of different metals on glass coloured by the oxide of copper, they were led to examine the reduction that the oxides with the minimum of oxidation exercised on the protoxide of copper, and chiefly that of the protoxide of iron of the forges; under the influence of heat the oxide of this iron readily reduced the protoxide of copper to metallic copper, and produced a metallic oxide (the peroxide of iron) soluble in glass, and giving to it a slightly yellowish tint. Heating, then, for twelve hours, a mixture of 300 parts of pounded glass, forty parts of protoxide of copper, and eighty of the oxide of iron, they have obtained a glass containing abundant crystals of metallic copper. If, therefore, the difficulty of manufacturing avanturine is to produce a glass filled with brilliant crystals of copper uniformly distributed, the problem is completely solved. The specimens submitted were somewhat opaque; but compared with the Venetian avanturine, the copper of both was observed with a good microscope to be crystallised in regular octohedrons.

*New Method of preparing Palladium.*—M. Dumas has submitted to the French Academy specimens of palladium—an ingot, a plate, and a lump of spongy palladium, extracted by MM. Schmidt and Johnston, of London, from the auriferous mineral of the Brazilian mines. Six thousand ounces have already been obtained from this mineral, which generally contains palladium, gold, silver, copper, and iron, by first treating it with nitric acid: the silver is then precipitated by a solution of chloride of sodium: pieces of zinc put into the liquor throw down the palladium and copper: these metals are again dissolved in nitric acid and supersaturated with ammonia, which retains the copper in solution: the ammoniacal salt of palladium is heated to redness, and the metal is left in a spongy state: it is then forged as platinum is. The method hitherto employed for extracting palladium from platinum ore is a long and costly one; this new treatment will, it is stated, render palladium much less rare in commerce.

*Steam Rivetting Machine.*—The principle of the steam hammer has been extended to the rivetting machine, and, instead of the usual cam and fly wheel, a steam cylinder, acting with a direct pressure, is employed to form the rivet in such cases. We cannot say that we think this a judicious innovation: the mould for the rivet can only be forced forward by the pressure of the steam, and a large piston will be required to give the necessary force. When a fly wheel is employed, there is the whole momentum of the fly wheel available for the formation of the rivet, and a small power continuously applied is thereby rendered sufficient for the purpose.

*An Ether Engine.*—A commission of the French Institute has undertaken to investigate the qualities of an engine invented by M. Trembly, which uses the heat in an engine twice over. Steam is allowed to enter a cylinder in the ordinary way, and after having performed its office, escapes to the condenser, which consists of a tubular vessel filled with ether. The temperature requisite for the condensation of the steam causes the ether to boil, and the vapour of the ether works the piston of another cylinder, and escapes into another tubular condenser, where it is condensed by the application of cold water. There is nothing very novel in this scheme: it will no doubt accomplish some saving of fuel, but the apparatus will be cumbrous and expensive, and if there be leakage, a loss of ether will be occasioned. Sir Humphrey Davy, many years ago, proposed the use of some of the liquefied gases, as an auxiliary to an engine, which are increased some atmospheres in pressure, by raising their temperature a few degrees, but objections of a practical nature have prevented the adoption of this suggestion, and appear likely to prohibit the adoption of M. Trembley's apparatus, which would be more cumbrous and less effectual.

*A New Rocket.*—An interesting experiment has been made on board the *Excellent*, at Portsmouth, with a new rocket invented by Mr. Hale, of Woolwich, the peculiarity of which is, that it requires no stick. Sixteen of Mr. Hale's six-pounder rockets were fired at various elevations, from a shot stand three feet long, formed by two iron rods secured together parallel with each other, but sufficiently apart to support the missile without its falling through; this small portable apparatus will allow Mr. Hale's rockets to be fired from a small boat quite as effectively and conveniently as from the deck of a line-of-battle ship. The first four rockets fired were projected in a horizontal direction with the greatest precision, and struck the water at distances varying from 500 to 700 yards, after which they rose at 700 or 800 yards further, *en ricochet*. The other twelve were fired at a greater elevation, and before striking the water *en ricochet* went a distance of from 2,000 to 3,000 yards, and their direction varied but very slightly. After the firing of Mr. Hale's rockets, six of the "service" twelve-pounder congreves were fired as a comparative experiment, at the same elevation as Mr. Hale's, but from a tube fifteen feet long, which ranged about the same distance as Mr. Hale's, and also pursued a very good direction. The twelve-pounder rockets now in use in the navy and army have sticks attached to them nine feet long, and the length of the stick increases in proportion to the weight of the rocket; whereas Mr. Hale's invention requires no such inconvenient auxiliary, and is, of course, less cumbersome, while equally efficient.

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## Art. X.—THE SOCIETIES.

Institution of Civil Engineers,—*March 3rd.*—The discussion upon the incrustation of boilers was renewed, and it was attempted to be shown, that viewed chemically, the muriate of ammonia might act prejudicially upon the copper and iron boilers; that the two metals in combination with a saline solution would induce a powerful galvanic effect, and [illegible] by the unequal action of heat on the different parts of the boiler, producing a thermo-galvanic circuit, considerable deterioration of the boiler would ensue. It was instanced, that on applying a small quantity of the muriate of ammonia in a locomotive boiler, the incrustation was immediately removed from the tubes; hence, it was argued, that a chemical action upon the metal must have taken place. On the other hand, after contesting the correctness of the chemical view assumed, it was asserted, that from the small quantity of muriate of ammonia used, no perceptible chemical action would ensue, and that in practice, after several severe trials of long duration in locomotive and marine boilers, when the water was subjected to the most delicate tests, no traces of metal could be discovered. It appeared that the action of the muriate of ammonia upon the carbonate of lime forming the incrustation was merely to disintegrate it, and render it soft and easy to be removed; for that after a given weight of incrustation had been boiled in a solution of muriate of ammonia for several hours, although it was rendered soft and pulverulent, the same weight still remained, thus proving that no sensible chemical combination had taken place. Numerous practical instances were given of the full success of Dr. Ritterbrandt's invention, and the general opinion appeared to be, that by the introduction of the system he had conferred a great benefit upon the engineering world, and most particularly upon railways, where the incrustation on the tubes of the locomotives was a source, not only of great expence, but not unfrequently the cause of accidents, as, by reducing the production of steam, the power was diminished, the speed could not be maintained, and collisions ensued. This process of keeping the boilers free from incrustation was therefore of great importance.

On the subject of the permanent way of the Dublin and Drogheda Railway, it was argued, that although, if taken at weight for weight there could be no doubt of the superior strength of the double T-shaped rail over the bridge-shaped rail, yet, that in practice, the travelling on the Dublin and Drogheda Railway was remarkably smooth and equable, which, it was contended, resulted from the firmness of the attachment of the bridge rail direct upon the sleepers, and from the general perfection of the laying of the line of rails. On the other hand, it was shown that a lighter double T-shaped rail, with good cast-iron chairs, and wooden trenails, for fastenings, and fixed upon triangular sleepers, as on the South-Eastern Railway, would, if the same machinery had been used in the preparation, and the same amount of attention had been given to the laying down, have produced a better line. It was admitted, that the great points in establishing a railway were to have heavier rails and stronger chairs laid with great accuracy, and constantly attended to; but that even then, unless the carriages were well constructed and adapted for their load, no smoothness or uniformity could be insured. The discussions were extended to such a length as to preclude the reading of any papers. After the meeting, Dr. Paltrineri exhibited to the members in the library his ingenious instruments for illustrating a system for obtaining the maximum of effect of all motive powers, by using the power of reaction as well as that of action.

*March 10th.*—The paper of the evening was an "Account of the Drops used for the Shipment of Coals at Middlesbro' on Tees, with a description of the Town and Port of Middlesbro'," by George Turnbull, M. Inst. C. E. The communication first gave an account of the town of Middlesbro' on Tees, and then described the docks, and the coal drops used there. The rapid rise of the town into commercial importance was treated of, and accounted for, chiefly by the fact of a branch having been constructed from the Stockton and Darlington Railway to Middlesbro', which, as a port for shipping, possessed many advantages over Stockton. As an example of this increased importance, it was stated that the quantity of coals sent down the Stockton and Darlington Railway, and shipped at Stockton and Middlesbro' in 1825-26 was 7926 tons, and in 1840-41 it had increased to the comparatively immense amount of 498,092 tons. The handsome manner in which the town was laid out and built, and its active manufactories, were also noticed. This commercial activity necessarily caused the want of a dock to be felt, and the present works were accordingly executed. The approach to the dock was stated to be by a channel of more than a quarter of a mile in length, which was kept open by sluicing; the entrance lock, built of stone, was 132 feet long, by 30 feet wide; and the area of the dock itself was about nine acres.

The branch railway diverges from the Stockton and Darlington line and terminates in ten double lines, leading to the ten coal drops. The manner of working the drops was thus described: the loaded waggon is run on to a cradle, or stage, which is arrested in a position immediately over the hatchway of the vessel to be loaded; it is then let down perpendicularly, by means of counterbalance weights, and when it has nearly reached the deck of the vessel, the contents are discharged into the hold; the counterbalance weight then preponderates, and the empty waggon is raised to the level of the rails. At the ordinary rate of working, about thirty waggons can be discharged an hour by each drop. In a statement annexed to the paper it is mentioned, that in the year ending July 1st, 1845, 505,486 tons of coals were shipped by means of the ten drops here described. The cost of the drops was 7300*l.* The total outlay for the whole works amounted to 122,000*l.* These works were designed by Mr. W. Cubitt, V.P. Inst. C. E., Mr. G. Turnbull being the acting engimeer.

Mr. Siemen's Chronometric Governor was exhibited, and after being explained to the meeting, its merits as a regulator of machinery were testified to by several gentlemen who had used it for corn and other mills, and it was acknowledged to be very superior to the ordinary pendulum governor of Mr. Watt.

*March 17th.*—The paper read was, "On the relation between the velocity and the resistance encountered by bodies moving in fluids," by J. M. Heppel. The author introduced his subject by demonstrating its scientific interest, and eulogizing the efforts of the illustrious men who have brought their energies to bear on it, from the time when Newton first turned his attention to that department of philosophy, to the more recent experiments of Palmer and Macneill, published in the Transactions of the Institution of Civil Engineers; and after apologising for his apparent presumption in venturing to add any thing to a subject already so extensively investigated, he proceeded to observe, that with the exception of the above-named researches of Palmer and Macneill, upon canal boats, all experiments have been made on bodies of too small dimensions. The communication then noticed the importance of the properties of larger vessels being more clearly ascertained, and gave a formulœ for doing this, by observing the diminution of velocity of the bodies in a given time, when the motive power was withdrawn; by this it would be ascertained whether any deficiency in speed arose from a defect in the construction of the vessel or of the propelling machinery. The following example was given:—If the vessel had been subject to the action of a force equal to its whole weight, the amount of velocity destroyed in a second would have been 32 feet per second, therefore as the distance of 32 feet is to the observed loss of velocity in feet per second, so is the whole weight of the vessel, as shewn by its displacement to the force by which this loss of velocity has been produced, that is, the united resistance of the water and the air, corresponding to the velocity in question. The method for ascertaining, experimentally, this position, was thus described. To the bowsprit of the vessel, sufficiently ahead to be out of the disturbed water, a small iron bracket should be attached, to suspend a slender rod, dipping at its lower extremity into the water, the part by which it hangs being a few inches below its upper end; upon the lower end beneath the water is a metal sphere, and to the upper end is attached a small cord, connected with a rectangular bent lever, the horizontal arm of which works against a graduated arc, so divided, that when the slender rod is hanging vertically, the ship being at rest, it should be opposite zero on the arc. When the ship is in motion, the sphere being acted upon by the resistance of the water, is forced from the perpendicular inwards towards the bow of the vessel; the bent lever is drawn upwards by the cord, and marks on the are the amount of force exerted. By watching the variation of this in given times and under certain circumstances, the diminution of velocity, and, consequently, the retarding forces, can be accurately ascertained.

Horticultural Society.—At a meeting on the 3rd inst., Dr. Lindley produced specimens of new potatoes, showing that the disease will be greater in the ensuing than the present season. He spoke from the experience of trials made in various parts of the kingdom, and under the most favourable circumstances; and he mentioned the curious fact that, while in some instances apparently sound potatoes had been produced from diseased sets, the disease had shewn itself in new potatoes, raised from sets of the year 1844, when the disease had not made its appearance. Dr. Lindley further stated, that the correspondence which had been carried on with the different British consuls was placed in his hands on the 28th ult.; amongst the most interesting of which was that from Washington, whence it appeared that the disease first presented itself in the United States in 1843, and had increased in intensity the two succeeding years. Dr. Lindley also stated that the disease is not confined to potatoes, but had made its appearance in carrots and onions.

Society of Arts.—*March 11th.*—The first communication was by Mr. Waterhouse, of Chesterfield, on his machine for the manufacture of Mechlin lace. It appears from the description of the machine, and the specimens of the lace exhibited, to be one of extraordinary capabilities. The number of warp threads in the width alone is 4700, and a corresponding number of bobbins, or weft threads, are required, making a total of 9400 threads, which represent the same number of bobbins, and are all kept in motion at the same time. In making pillow lace it requires as many hands as there are bobbins, for on the cushion one hand must wait for the other in order to obtain the requisite crossings of the threads. Some idea may therefore be formed of the intricacy of the machinery, and of the ingenuity displayed in its arrangement, as by it, every motion given to the threads by the hand of the workman is exactly given by the machinery, but with much greater rapidity and precision. The process of the manufacture was described at considerable length, and illustrated by diagrams and parts of the machinery itself; there were also various specimens of the lace exhibited, one of which was twenty-six yards long, and four yards wide, and had four patterns upon it. The number of motions, or throws, that would be required to produce a similar piece of lace by hand would amount to not less than 2,111,616,000. The laee made is in no respect inferior to the foreign lace, but was pronounced by several gentlemen connected with the manufacture, and who took part in the discussion which ensued, to possess all the properties of the foreign article.

The next communication was by Dr. Paltrineri, on a new Steam Engine, Magnetic Engine, and other machines, in which the moving power is applied simultaneously, by action and reaction, to the work to be performed, beiug illustrations of a system for obtaining all motive power and maximum of effect. Dr. Paltrineri conceives that the maximum of effect is to be obtained by applying simultaneously the action and reaction of every motive power with equal velocities to the production of the useful effect; he showed a very beautiful double Turbine, in which the water, steam, or other moving fluid, is applied by means of two concentric wheels, through which the fluid passes successively, and by this means he showed that a residual effect, which is lost in the ordinary single wheel, would be rendered available by the double. He proceeded to show the same results in the case of his new magnetic engine, and he illustrated the fact by a machine of great accuracy, in which the constant force of a spring is applied to raise a weight,—first, by having one bend released, and the other fixed, and next, by releasing both bends simultaneously, and in the latter case he showed that the maximum of effect is utilised.

Royal Institution.—*March 6th.*—A lecture was given by Professor Faraday, "On the Magnetic Condition of Matter." We formerly stated the nature of his discovery; and we shall now confine ourselves to an outline of the illustrative experiments. The instrument used was a very large horse-shoe electro-magnet—the power derived from the battery of Mr. Grove. The two poles were fitted with two short bars of soft iron, terminating at one end in cones, by which means the poles could be separated, or made to approach at pleasure. The Professor first proved, that bodies termed magnetic, in the ordinary acceptation of the term, such as iron, nickel, cobalt, &c., will, if freely suspended over the poles of the magnet, arrange themselves in an axial position, or in the lines of magnetic force, and that, moreover, if brought within the sphere of action of either pole, they will be attracted. Many other bodies, which hitherto have not been regarded as magnetic, and which, when subjected to the influence of ordinary static magnets, appear to be unaffected when brought into the sphere of action of this powerful magnet, will immediately take up this axial position. This fact was proved by a small bar of peroxide of iron, and a little roll of paper. Another great class of bodies, which have hitherto been deemed to be unaffected by the magnetic force, are found, in direct opposition to the former, to arrange themselves in an equatorial direction to the poles, or at right angles to the magnetic force, and are also repelled by either pole of the magnet; these Professor Faraday has called diamagnetics. The term diamagnetic was first given to glass and other bodies, because they appeared to allow the magnetic force to traverse or pass through them, and has still been retained in connection with their property of being repelled from either pole, and of arranging themselves at right angles to the lines of magnetic force. To illustrate this diamagnetic property, the Professor first suspended a piece of heavy glass between the poles of the magnet, so as to swing freely. The instant that contact with the battery was made, the glass was repelled from the pole to which it was nearest, and arranged itself in an equatorial direction. A bar of bismuth, a small stick of phosphorus, and water, were also used in experiments, and all under similar circumstances arranged themselves in an equatorial direction. To exhibit more clearly the repulsion from either pole of such bodies, a very delicate experiment was had recourse to. To the end of a small rod, freely balanced upon a steel point, a small bar of bismuth was attached, brought between the poles of the magnet, and repulsed from either pole as soon as the contact with the battery was made. The law in this respect is, that all such bodies are repelled from the stronger to the weaker places of action. The diamagnetic property is possessed by an immense variety of bodies, amongst which were named such things as an apple, a bird, wood, leaves, frogs, biscuits, and even the human subject, were it possible to suspend him. A piece of wood and a slice of apple were experimented on, and in both cases the attempt was perfectly successful. Another curious experiment was exhibited. If to the end of a piece of thread a small cube of copper, a diamagnetic, be attached, it will, by the torsion of the string, spin round rapidly. But if it be placed between the poles of the magnet, it will immediately, upon connection being made with the battery, stop. To whatever class, whether to the magnetic or diamagnetic, a body belongs, its compounds also belong. Thus, iron is magnetic; a solution of sulphate of iron is also magnetic. And here another curious fact is elicited—namely, that by the action of magnetism upon solutions of the rarer metals, such as cerium, magnesium, &c., we can ascertain what is their magnetic condition. And, further, by thus magnetising solutions, such, for example, as sulphate of iron, we get a liquid, transparent magnet, in which we can look.

The last question adverted to was, the effect of magnetism upon air; examined and tried in every way, rarified, condensed, or in its natural state, air appears to be utterly unaffected. The same law holds good with all vapours, but the moment they are reduced to a liquid or solid form, they become either magnetic or diamagnetic. From this it would appear that air possesses neither property; but even this assertion cannot be confidently made, for, according to the medium in which it is suspended, air becomes either magnetic or diamagnetic. To illustrate this, the following experiment was shown:—a tube of air was first suspended in water between the poles of the battery. Although the water is diamagnetic, the air became magnetic; but when suspended in a solution of sulphate of iron, of itself magnetic, it became diamagnetic. From all these experiments, Professor Faraday concluded that air held a sort of zero point, from which on the one side branched the magnetics, on the other the diamagnetics, and that magnetism influenced, in one or other of these ways, all bodies. He concluded by observing that this was a field in which he believed much was yet to be done, and that this property of diamagnetism, inherent in so many bodies—the sea, lakes, rivers, rocks, &c.,—was not without its importance in the regulation of the system of the universe, although as yet we are ignorant of the part it plays.

*March* 13*th*.—Mr. Pellatt, "On the manufacture of glass," commenced wit a brief historical sketch of the introduction of glass making into this country. He then described the crucibles or pots of two kinds, open and closed, in which the metal, as glass is technically called, is melted; the materials, silica and alumina, of which they are made; and the care and attention required in their construction. Next he gave an account of the furnaces for the reception of the crucibles, the air-tunnel beneath, and the manner in which the flame passes over the contents of the pots, fusing the upper surface, the melted matter running down, lifting and thus keeping the raw ingredients in contact with the fire. It is important that the furnace be well built and arranged—that it should be a good-going furnace—that it should found in a given time; for the more silica, the better glass; and unless the founding be completed in a certain time, more alkali is used, and a worse glass produced. The tools employed in casting and blowing are few and simple: a blowing iron pipe, on which the melted glass is taken up little by little; a punty-rod, pincers, shears, and a chair with arms, on which the punty-iron is rolled. Three men work together—the gatherer of the metal from the crucible, the blower, and the finisher; and from them the glass goes through the annealing kilns, which were also described. Plate-glass is the only cast glass; it is poured upon the casting-table of iron bevilled at the sides, and then flattened out with an iron roller. In its rough state it is transferred to a wooden table, to be cut and polished, which is a tedious and expensive process. Crown, or ordinary-window-glass, is made entirely by blowing, gathered and worked in a mass of about 11 pounds, to form a "table" of glass, round and flat. It is blown into a large bowl-shape, like a gold-fish globe, taken by the finisher to the flashing furnace, there heated up, and turned rapidly round on the punty-rod. The workman, when he sees it waving, withdraws it from the furnace, increases the rotation, and the centrifugal force flashes it out to a flat round of glass. The cutting up this round into squares for use causes a waste of about four pounds out of the eleven pounds, increasing, therefore, the cost to the consumer. With a view to avoid this waste, German sheet glass, new in this country, is formed out of a long blown cylinder, annealed and cooled, cut with a diamond along its whole length, annealed up, softened and flattened, again annealed, and then ready for cutting into squares—not, however, of a large size. Bottle-glass forms the largest portion of the glass manufacture of England. The commonest materials are used, pit-sand, refuse alkalies, red clay, and common salt, measured roughly—barrow-loads and sometimes cart loads. By the three workmen above-mentioned, 120 dozen of port-wine bottles are made in ten hours, or two per minute. The price at the manufactory is 14*s*. per gross, or 6*l*. per ton. This was stated in relation to iron at 7*l*. 10*s*. per ton, or as three bulks for one, as 2*l*. to 7*l*. 10*s*. for equal specific gravities. Flint glass for table purposes is composed of Alum-Bay sand, red lead, and the best alkalies, the carbonate or nitrate of potash. Every flint-glass manufacturer has his own mixture. The best formula is, 1, 2, 3, alkali, lead, sand; but few furnaces will found this; therefore imperfect mixtures, and hence the cause of the breaking with hot water. The principal point to be attained is colour and brilliancy: Mr. Pellatt explained the methods adopted for this, and stated his views of the many imperfections, striæ or cores, like newly mixed spirits and water, attributable chiefly to the manner of fusing, likewise their divergence of light in reference to astronomical purposes, and regretted that, with all the pains taken, glass is yet an imperfect substance. In concluding, Mr. Pellatt enumerated the metallic oxides, chiefly the protoxides, used for colouring glass, either on the surface or in the body; and dwelt more particularly on the ruby colour of the ancients. Lately a patent has been taken out for staining this beautiful tint, which, though superficial, is burnt in; casing white with coloured glass, and cutting into patterns, were also mentioned, aud various specimens exhibited.

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## Art. XI.—LETTERS TO THE CLUB.

In October, 1840, I conceived the idea of working steam and air expansively on incline surfaces, and will thank you to insert the following considerations on the subject.

First, then, action and re-action are equal.

A pressure of one atmosphere, without a bevelled tube, would push the carriage with a force of 15 lbs. if the aperture be 1 in. and with an expenditure and velocity due to that pressure. But by adding a long bevelled tube, it would require a larger opening to emit the same quantity, because the *local* atmosphere, or pressure in the tube, would be greater than the general atmosphere outside. Then let us suppose the general atmosphere to be a comparative vacuum, would not the push be nearly 30 lbs. instead of 15 lbs. It is surely incorrect to call the atmosphere the fulcrum "by the reaction of the atmosphere," and this mistake of first principles has caused many blunders.

It appears that in the aperture, without a tube, the velocity nearly overcomes the pressure, but on the opposite side of the feeder the pressure is steady, and the elastic medium motionless. It is, however, necessary for the feeder to be large, as compared with the opening to produce this effect. On one side there may be a pressure of 15 lbs. per square inch on 100 in., while, on the opposite side, only 15 lbs. on 99 in. This principle can be tested only by proper proportions which may be arranged by the practical mathematician. To make the local atmosphere within the tube dense, and in sufficient quantity to start, is what is wanted. A tube 40 ft. long, might be economical for thirty-two miles per hour, but it might require one 160 ft. long for eight miles. Now the pressure within a tube 160 ft. long, having an area 100 times greater at the opening than at the feeder, must have great power over a train of heavy carriages, or a vessel, blowing them along like blowing up a boiler. Nevertheless there may be a loss or slip in the dead push or start, but the locomotive is at fault here, and so is the screw-paddle. In truth, the whole is a case analogous to sailing or wind-mills. Whatever power may be lost by this mode of reaction, may be more than balanced by the extreme simplicity of the apparatus. But it is proper here to notice the principles of action, and the perfection the locomotive engine has been brought to. The steam, then, not only follows up the piston to blow it down, but this same steam, in going out, reacts to blow it down also,* and the piston becomes, so to speak, the fulcrum to the waste steam. To a common observer this double action is not conceived, and the whole is certainly splendidly complicated. Not so in "Avery's Reacting Engine." This is the *ne plus ultra* of simplicity, and evidently a regular action. Fifteen pounds will hold a fifteen horse power—that is, a pressure of 120 lbs. per square inch on two openings both together, being only the one-eight of a square inch. And this is in reality a fifteen horse engine, using no more steam than the best piston engines, if properly geered and applied to any quick rotary motions. To be plain, the whole matter has been mystified and neglected for more than ten years, while working Avery's engine, and more than 2000 years since Hero's toys. Vested interests and professions have stifled inquiry in this, as in most other things. The conversation about it has hardly a parallel, except the silly arguments that have been used from time to time on the power of expansive steam engines, and of the supposed power of the atmospheric power machine.

In round numbers, steam moves 1,000 miles per hour, at 15 lbs. pressure, but a pressure of 30 lbs. gives little increase on account of the excessive friction on the parts. A bevelled tube 40 ft. long, with a mean area of one foot, contains 40 ft. of air equal to 3 lbs. weight. Now the whole of these atoms are to be put in motion. The question then is this. Can the power, condensed air or steam, be detained long enough to react, without condensation and without inconvenience, to suit all velocities and operations. If it can, and if action and reaction are equal, how can the power be lost? Of course the pressure in the tube, say $7\frac{1}{2}$ lbs. near the aperture, leaves only an effective pressure of $7\frac{1}{2}$ lbs. instead of 15 lbs., BUT ONLY ABOUT HALF THE POWER ISSUES OUT, *leaving the remaining* $7\frac{1}{2}$ *lbs. pressure in the tube, and the motion due to that pressure, to act progressively, over and over again on the incline sides of the tube, till all the motion is dissipated.* If, by the addition of a tube, the velocity of the power in the aperture of the feeder be reduced from 1,000 to 500 miles per hour, then 500 ÷ 8, the supposed velocity of the power or medium on leaving the tube, demands, with the expansion, an increased area of fully 100 times; these proportions varying with the velocity of the machine and other circumstances.

On the other hand, it may be conceived, that as the elastic medium moves along the tube in contrary directions to the motion of the tube, that it transfers power only in the direction of its progressive motions. But it must be admitted that in Universal Nature all matter in progressive motion is necessarily orbital. In a parallel tube, the progressive motion may be in excess, having no fulcrum to act on, on the contrary, producing friction, which tends to carry the tube along with it. But the case is very different with a widening tube. The orbital motion may be in excess, and, hence arises intense motion in every direction, producing an action or pressure on the inclined surface of the tube, which is communicated to the carriage or vessel. In rotatory motions, when the elastic medium *moves faster* than the machine, the length or surface of the tube may be decreased by curving the tube.

Lastly, this simple machine may be likened to a huge rocket, with a long tube or horn attached. Now it is evident the atmosphere presents little resistance to the issuing medium from a rocket. Why then do professors still persist in calling the atmosphere the fulcrum, and to exclaim "that if they saw Barker's mill working in a vacuum, they would not believe it!"

Nearly all the practical men I have conversed with for more than twenty years, and I don't remember an exception, whether engineers, millwrights, millers, or manufacturers, pronounced this principle applied to water-wheels inferior to the best overshot water-wheel. But they, with many professors and mathematicians, were mistaken. It has turned every thing topsy-turvy, and will create a great revolution in power-machines. The savings will be vast and various, if carried out extensively only for water-power. Let us try to solve the major problem by applying to this principle the principle of expansion. Then may Watt's principles give place, through Avery, to the more ancient one of Hero; as Ptolemy's principles of the Universe have, through Copernicus, given place to those adopted by the ancient Chaldeans. Thus verifying the words of the Preacher "there is no new thing under the sun."

*Woolwich,* HENRY PRATT.

[Mr. Henry Pratt would be more convincing if he dealt less in bombast, and placed more confidence in syllogisms than in notes of exclamation. He appears to be in considerable bewilderment respecting a very plain matter. A jet of steam might be expected to urge forward a railway train without material loss of power, if the mouth of the jet could be so widened that the steam would only flow out with the velocity of the train's motion, but an immense size of tube would be requisite for this purpose. If the steam issues with a greater velocity than that of the train, there will be a loss of power proportionate to the difference, and the whole of the power will be lost when the steam issues, while the train is stationary. Mr. Pratt may easily find the number of square feet of orifice necessary, by taking the pressure of the wind per square foot at the velocity of the train, and reducing that to horses power.]

## ART. XII.—RITTERBRAND'S PROCESS FOR PREVENTING BOILER INCRUSTATIONS.

THE scepticism we have on various occasions ventured to express of the utility of this much vaunted process for preventing incrustations in steam boilers is now, it appears, re-echoed by Mr. Robert Stephenson, and other eminent engineers, whose opinions are entirely confirmatory of our objections. At a late meeting of the Institution of Civil Engineers, Mr. Robert Stephenson stated, that whatever might be the efficacy of Dr. Ritterbrand's plan in the prevention of incrustation, he considered its employment to be dangerous and inadvisable, inasmuch as it would exert a corrosive action upon the machinery which would be a greater evil than the one it professed to alleviate. Many substances Mr. Stephenson remarked might be introduced into boilers which would prevent the formation of scale. One of these was muriatic acid, which had been long ago employed by Mr. Gurney to cleanse his boilers, and which had been tried for the prevention of incrustation upon the London and Birmingham Railway, but any such substance is attended with the obvious objection that it can only be effectual when there is uncombined acid in the water, and that acid will not wait for the elaboration of the lime wherewith it may be saturated and made inert, but will at once attack the metal with which it may be in contact. If the use of such substances, moreover, be permitted at all, it will be difficult to guard against the accident of their being sometimes used in excess, and in a brief period irretrievable damage to the machinery may thus be occasioned. Muriate of ammonia is not so destructive a material as muriatic acid in its undiluted state, and there is perhaps less danger, therefore, in its practical application, nevertheless, sal ammoniac, as is known to every engineer who has made rust joints, is a most corrosive material, and whatever may be thought by the diggers of earth and architects of sleepers, *he* at least will have no difficulty in understanding how the use of ammonia water in the boiler may be productive of injurious internal corrosion. We again caution those misguided persons who are attempting to urge this nostrum into adoption, of the danger as well as the folly of their courses. Does Mr. Gooch stand so high in public opinion that he can afford to tamper with his reputation? Until now we have known nothing of him but what is creditable to his talents, but his fame is not so firmly established that he may not blast his prospects by taking up even one untenable position. The first qualification of an engineer is to be safe: it is not indispensable to his fame that he should advance, but he should never be called upon to retreat; and however brilliant may be his talents, the public will lose all confidence if he makes occasional lapses. The large sums with which the civil engineer has to deal with must not be exposed to hazard; and the first question asked, therefore, of an engineer's qualifications is not whether he is original or accomplished, but whether he will attempt nothing that he will not certainly accomplish; an admiration for the man may consist with a want of confidence in the engineer, and a wise man will often restrain the impulses of his genius where his ambition is to acquire a professional reputation. If this course be judicious even in the case of enterprizes of originality and promise, how much more should it be adopted in the case of schemes of more than doubtful utility, and which have already been tried and neglected! If Mr. Gooch is determined to become a martyr to the cause of engineering innovation, let him at least select some worthy object for which to expire; but we trust while it is yet time he will loose his hold of such untractable divinities and suffer them to career over the precipice to which he would be carried, and from which they cannot be saved.

We have already spoken at such length of the merits of Dr. Ritterbrand's process that we believe we have little to add now upon that subject. Mr. Stephenson's objection was chiefly directed to the boiler, but as we shewed in our former remarks, the engine would also suffer, as the ammonia would, to some extent, be carried over by the steam. We have often remarked that those marine boilers in which there was the largest deposition of scale underwent the most rapid internal corrosion in the region of the steam chest; a result attributable, as we conceive, to the expulsion of the muriatic acid from the salt. By Dr. Ritterbrand's process this action would be much increased, to say nothing of the corrosive effects of the solution on the iron where it is in contact with it, and those who have seen the seams of a new boiler that had been washed by sal ammoniac water to fill the minute leaks by oxidation, may form some conception of the amount of decay incidental to the continual operation of such a corrosive agent. Upon the various parts of the engines, and the valves, pipes, and gauges of the boiler, this unintermittent action could not fail to be injurious, and much inconvenience might arise should the cocks refuse to turn, or the safety valves be glued to their seats by oxidation. Dr. Ritterbrand's plan may be endurable, perhaps, for the space of six months, in common with the Argand furnace, and other schemes which have been exposed in our pages, but its life must be a short one in spite of Polytechnic puffs and the other restoratives of a galvanic existence.

## ART. XIII.—THE ENGINEERS OF THE NAVY.

THE pay of naval engineers has, we observe, been increased, but their rank in the service remains in the same anomalous position as ever; such a change we predicted would not satisfy any party, and we believe we may say that the discontent among naval engineers incidental to the inconsistent relation of their rank and functions continues unabated. In the *Retribution* or *Terrible* for example, of 800 horses power, when the engineer has from 20 to 30 men under his direction, or in other large steamers where nearly half of the ship's crew is under his control, the engineer is himself below the carpenter who has nobody, or perhaps one man under him, and is exposed to the cavalier airs of any superfine juvenile of the quarter deck who may think severity is the only credential of command. With sensible captains or lieutenants the respectable engineer is safe, and there would be only a formal cause of objection if with such only he had to deal; but even supposing that all officers in command of navy steamers came under this description, what protection has the engineer against the spite or presumption of underlings when the captain's back is turned? It cannot be denied that in most steam vessels a jealousy exists between the engineering and the nautical departments; the sailors regard the engineers as interlopers, who have monopolised all the important duties of the ship, reducing them to the condition of very inconsiderable persons; and the engineers feel that while they are doing every thing necessary to sustain the vessel's progress, and believe that they could do without the sailors altogether, they are defrauded of their fair measure of authority and consideration. The only way of softening these jars is by keeping each to his own department, and the sailors should be prohibited from intermeddling with the engine, if the engineers are to be prohibited from intermeddling with the ship. The rank of the engineer must be raised to a point answering to his responsibility and the importance of his functions, before a satisfactory efficiency in the engine department can be attained, or any lasting peace cemented; and, although naval officers may be reasonably jealous of an increased importance being given to the engineers, yet the Admiralty has other considerations to weigh than those which appertain to personal jealousies; and the ruin or greatness of our steam navy hangs very much upon this slender thread. If the reasonable concession asked by naval engineers be not made, the best men will leave the service, and, although the Admiralty may still secure the services of engineers of some kind or other, yet will the steam navy gain by the exchange? The ambition ought to be to make the steam navy better rather than suffer it to become worse, and how will the Admiralty answer to the country for such a declension? At the present moment, moreover, the Admiralty is not safe against the effects of a combination, and if the strongest engine factory in the country can be stopped by a strike until certain demands be complied with, who can say that the same weapon may not be used against the Admiralty itself at a critical juncture. A higher class of engineers would have less sympathy with trades' unions, and would be less exposed, or better able to resist their seductions, whereas the present discontents expose the country to needless danger, and unless redressed by timely concession, can only end in the decay of efficiency in the steam navy, or in an angry triumph over the Admiralty, when reformation has been so long resisted that concession becomes defeat.

## ART. XIV.—PAPERS FOR REFERENCE.

### A BILL TO AMEND AN ACT FOR REGULATING THE CONSTRUCTION AND USE OF BUILDINGS IN THE METROPOLIS AND ITS NEIGHBOURHOOD.

*Preamble:* 7 & 8 *Vict.*, *c.* 84.—Whereas an Act was passed in the session of Parliament holden in the seventh and eighth years of the reign of her present Majesty, intituled, "An Act for regulating the Construction and the Use of Buildings in the Metropolis and its Neighbourhood," whereby, amongst other provisions, one of her Majesty's principal Secretaries of State was empowered to appoint two persons, being of the profession of an architect or surveyor, to be official referees of metropolitan buildings for the purposes of the said Act, and from time to time, as he should think proper to remove such official referees, and in their place to appoint other persons so qualified; and the Commissioners of Her Majesty's Woods, Forests, Land Revenues, Works, and Buildings, were authorized to appoint a registrar of metropolitan buildings, who should hold his office during the pleasure of the said commissioners: and it was enacted, that the determination of such two official referees, or of one of them, with the assent of the said registrar, as to all or any matters referred to them, should be binding on all parties to such reference; and that any matter required or permitted to be done by the official referees might be done by either of them with the assent of the said registrar, unless express provision to the contrary should be made, and if done by any one of them, with such assent, should be as valid and effectual as if done by both of them; and by the said Act the said official referees were prohibited from acting as surveyors, and every person being or becoming commissioner, receiver, steward, or agent of any owner of houses within the limits of the Act, was disqualified from holding the office either of official referee or of registrar under the said Act.

And whereas the duties and qualifications for office of the registrar of metropolitan buildings are of a character wholly distinct from the duties and qualifications for office of the official referees, and it would conduce to the more satisfactory execution of the recited Act if there were three official referees (all of them being of the profession of a surveyor or architect), and the acts and awards of such three official referees, or of any two of them, were made as valid and binding as if the same had been done or made under the authority of the recited Act by the two official referees thereby authorized to be appointed, or by one of them, with the assent of the said registrar; and for the purpose of obtaining persons duly qualified to discharge the functions of official referees without increase of charge to the public or the localities comprised within the limits of the recited Act, it is expedient to relax in manner, hereinafter mentioned, the prohibitions and disqualifications appertaining to the office of official referees under the said recited Act.

1. *Appointment of an additional Referee.*—Be it therefore enacted, by the Queen's most excellent Majesty, by and with the advice and consent of the Lords spiritual and temporal, and Commons, in this present Parliament assembled, and by the authority of the same, that it shall be lawful for one of Her Majesty's principal Secretaries of State, and he is hereby empowered at any time after the *passing of this Act*, and from time to time, to appoint a person, being of the profession of an architect or surveyor, to be an official referee of metropolitan buildings, in addition to the official referees authorized to be appointed by the recited Act, and from time to time, as he shall think proper, to remove such additional official referee, and to appoint any other person qualified as aforesaid in his place; and every official referee to be appointed under the authority of this Act shall make the same declaration of official fidelity, and have the same duties, powers, authority, and jurisdiction, and be subject to the same rules and regulations (save as hereinafter varied or relaxed) as if the said recited Act had authorized the appointment of three official referees, and the official referee appointed under the authority of this Act had been appointed official referee under the authority of the recited Act.

2. *Two Official Referees may act.*—And be it enacted, that all acts, matters, and things, by the said recited Act required, directed or permitted to be done by the official referees of metropolitan buildings, or by one of such official referees, with the assent of the registrar, may be done by the official referees appointed and to be appointed under the authority of the recited Act and of this Act, or by any two of them; and that the acts, certificates, awards, orders, and determinations of any two of the said official referees shall be as valid, binding, and effectual, as if the same had been done, signed, made, or determined by all the said official referees; and the assent of the said registrar of metropolitan buildings shall not be required to give effect to the same; and the assent of the said registrar shall not render valid any act, certificate, award, order, or determination, done, signed or made by one only of the said official referees, which would not be valid without such assent.

3. *Official Referees may act as Surveyors with permission of Secretary of State, and disqualifications may be relaxed: Special Referees to be appointed in certain cases.*—And be it enacted, that notwithstanding any thing in the said recited Act to the contrary contained, it shall be lawful for one of her Majesty's principal Secretaries of State, if and so long only as he shall think proper, by any writing under his hand, to permit and authorize any one or more of the persons who for the time being may hold the office of official referee to act as surveyor, either alone or with any partner, or by an agent; and no person shall be ineligible or disqualified from holding the office of official referee by reason of his continuing to act as a surveyor with such permission as aforesaid, or by reason of his being or becoming commissioner, receiver, steward, or agent, for or on behalf of any owner of houses or land within the limits of the said recited Act, provided the fact of such person being or becoming such commissioner, receiver, steward, or agent, be notified to one of Her Majesty's principal Secretaries of State, and licensed by him in writing, before such person be appointed or continue to act as official referee: but it shall not be lawful for any person holding the said office to act as official referee in the case of any building or matter in which he shall be employed as architect or surveyor, or where he shall be the commissioner, receiver, steward, or agent of any person interested in such building or matter; and if it shall happen that more than one of the said official referees shall be employed as architect or surveyor to the same building or matter, or shall be the commissioner, receiver, steward, or agent of any person interested therein, or if any disagreement or difference of opinion shall arise between any two official referees who shall act as to such building or matter, not being employed as architect or surveyor, or as commissioner, receiver, steward, or agent of any person interested therein, it shall be lawful for the Commissioners of Her Majesty's Woods, Forests, Land Revenues, Works and Buildings, from time to time, upon the report of the official referees or any one of them, or upon the application of any person interested in the matter in dispute, to authorize one or more competent persons, being of the profession of an architect or surveyor, to be special referees in respect of such particular building or matter, either in conjunction with the acting official referee or referees, or alone, as the case may require; and every special referee authorised by the said commissioners shall, as to the particular building or matter for which he is authorised, have the same power, authority, and duties, as if he had been appointed an official referee under the authority and for the general purposes of the said recited Act; and it shall be lawful for the said commissioners to assign to every such special referee such part of the remuneration of the official referee or referees who shall be disqualified as aforesaid from acting as to such particular building or matter, or otherwise to remunerate him as the said commissioners shall think fit.

4. *Offices vacant.*—And be it enacted, that if any official referee shall act as surveyor, either alone or with any partner, or by an agent, or as commissioner, receiver, steward, or agent, for or on behalf of any owner of houses or land within the limits of the said recited Act, without the license and consent in writing of one of Her Majesty's principal Secretaries of State, or shall continue to act as surveyor, either alone or with any partner, or by an agent, or to act as such commissioner, receiver, steward, or agent, as aforesaid, after such licence and consent shall have been withdrawn or shall have expired, then he shall cease to be qualified to hold the office of official referee, and thereupon such office shall be vacant, without prejudice nevertheless to any acts done by him in his capacity of official referee, so far as other persons are affected thereby.

5. *Salaries of Official Referees.*—And be it enacted, that it shall be lawful for Her Majesty from time to time to grant such salaries for the remuneration of the said official referees respectively as Her Majesty shall, as to each of them, be pleased to appoint, not exceeding in the whole for the three referees the sum of *two thousand* pounds per annum.

6. *Contributions to be paid to the Consolidated Fund and Salaries paid thereout.*—And whereas for the purpose of providing for the payment of a portion of the salaries of the official referees and registrar under the said recited Act, it was by the said Act enacted, that the lord mayor and aldermen of the city of London, should direct the chamberlain of the said city, and the justices of the peace for the several counties of Middlesex, Surrey, and Kent, should direct the treasurer of such respective counties to pay, by two half-yearly payments in the months of June and December in every year, to or into the hands of the cashier of the Commissioners of Works and Buildings on account of the said official referees, and of the said registrar, the several sums of money therein mentioned as and by way of contribution to such salaries; and it was enacted, that the balance of such salaries should be payable and paid out of the Consolidated Fund of the United Kingdom: and whereas such salaries are by the said Act directed to be paid quarterly, and the contributions towards payment of the same being payable half-yearly, it has not been practicable to pay such salaries as directed by the said Act, and it has been found inconvenient to pay the same in part out of monies contributed by the said city and counties respectively and in part out of the Consolidated Fund of the United Kingdom; BE it therefore enacted, That the several sums of money which under the said recited Act are payable by the chamberlain of the city of London, and the treasurer of the counties of Middlesex, Surrey, and Kent respectively, to the cashier of the Commissioners of Works and Buildings on account of the said official referees and of the said registrar, and all arrears and future payments thereof, shall, instead of being paid to such cashier on such account as aforesaid, be payable and paid into the receipt of Her Majesty's Exchequer, and carried to the account of the Consolidated Fund of the United Kingdom of Great Britain and Ireland; *and the salaries of the official referees and registrar of metropolitan buildings for the time being, and all arrears thereof, shall be paid wholly out of the said Consolidated Fund by the Lord High Treasurer or the Commissioners of Her Majesty's Treasury for the time being; and such salaries shall accrue from day to day, and be paid quarterly on the first day of January, the first day of April, the first day of July, and the first day of October in every year;* and every official referee and registrar shall be entitled to a proportionate part of his salary from the day of his appointment to the next succeeding quarter-day of payment, and from the last quarter-day of payment preceding his death, discharge from or ceasing to hold the office of official referee or registrar (as the case may be) to the day of his death, discharge, or ceasing to hold such office.

7. *Public Act.*—And be it enacted, that this Act shall be deemed to be a public Act, and shall be judicially taken notice of as such by all judges, justices, and others, without being specially pleaded.

8. *Act may be amended.*—And be it enacted, that this Act may be amended or repealed by any Act to be passed in the present session of Parliament.

## SCREW PATENTS.

An application has recently been made to the Judicial Committee of the Privy Council, by Mr. Woodcroft, for the extension of his Patent for a Screw Propeller. Mr. Jervis appeared to support the application; and the Solicitor-General, besides watching the proceedings on behalf of the Crown, appeared in oppo- sition on behalf of Mr. Smith and the Ship Propelling Company.

Mr. Jervis, in stating the case for his client, said, that the invention for a renewal of his patent right to which application was now made, differed entirely from every other kind of propelling screw in existence. It was formed on the principle of a spiral, represented by the winding of a circular line round a cylinder. The patent was granted in March, 1832, and he now applied to their Lordships for an extension. The history of patents for screw propellers (of which he enumerated the advantages) was as follows:—In 1794, Mr. Littleton had taken out the first patent for an invention of that kind, which he proposed working by hand with the capstan, and which was to be either partially or totally immersed in the water, according to circumstances. The next patent for a screw was Mr. Shorter's, taken out in July, 1800. It consisted of the two vanes of a smoke-jack, not submerged, and adapting itself to the movement of the vessel by a universal joint. In 1815, Mr. Trevithic proposed the Archimedian or fixed screw, working in a cylinder. In July, 1816, Mr. Millington got a patent for the application of a smoke-jack placed beyond the rudder, and worked with the universal joint. In February, 1825, Mr. Perkins patented an invention for having two vanes, working in opposite directions, placed at the side of the rudder. In 1829, Mr. Commeraux patented a perfect one-turn screw fixed parallel to the keel, and held by a stage erected for that purpose beyond the rudder. The date of Mr. Woodcroft's patent was in March, 1832, and the difference between his spiral and the screw of his predecessors was, that whereas the former consisted of a straight line coiled round a cylinder, the latter was made by a circular line so coiled round. The effect of this invention had been to economize the power of the engine, to destroy the vibration, and to produce a greater speed with fewer revolutions. If a spiral worm was coiled round a cylinder, the angle given thereby would decrease, and the "pitch," therefore, increase throughout its length. Mr. Woodcroft, in his specification, proposed applying this spiral in different parts of the ship, and amongst other places before the rudder-post, by cutting away a part of the hull. Mr. Smith's patent, which was on the application of a perfect screw of one turn placed in the centre of the dead wood, was taken out in May, 1836. In 1837, Mr. Ericson patented an invention which differed from that of Mr. Perkins only in being submerged and placed behind the rudder. In 1838, it being ascertained that a perfect screw of one or two turns could not be worked from the obstruction of the back water, Mr. Lowe took out a patent for cutting the screw into arms or blades, which worked between the rudder and the stern-post. In April, 1839, Mr. Smith entered a memorandum of disclaimer, by which he stated that he found that a screw of two turns would not do, that the true principle was to take two half turns of a screw planted in the centre of the "dead wood." After explaining the evidence that he had to produce as to the usefulness of Mr. Woodcroft's invention, Mr. Jervis concluded—Having expended 1,200*l.* and upwards in pushing his invention, and having received in return only about 430*l.*, Mr. Woodcroft was entitled to such a renewal of his patent as would enable him to remunerate himself, not only for capital laid out, but for the time and talent which he had spent upon it. Mr. Woodcroft had made several other inventions, and in applying for a renewal of his patent, he proposed introducing an improvement on the original plan, by which to alter at pleasure the variations in the pitches.

Mr. Carpmael stated that he had studied the subject of the screw propeller for several years. In the use of ordinary screws, the water was put in motion by the first part of the screw, and being of the speed of the second part of the screw, choked the screw. The advantage of this screw was that the second part was so constructed as to outstrip the motion of the water, so that the instrument was an operative one, whatever might be its length. All other screws consisted of a straight line wound round a cylinder, but that of Mr. Woodcroft was a circle, or segment of it, wound round a cylinder. Tredgold, in his work on propulsion, proposed that a screw should go on with a decreasing angle on an increasing pitch, but he stated nothing about a circle wound round a cylinder, which was Mr. Woodcroft's principle.

Mr. J. Grantham, civil engineer, stated that in 1842 he had built a vessel with Woodcroft's propeller, and an expanding pitch of one-tenth. She answered very well, and he had seen her for six months at intervals. The firm had failed, and she had been sold. Mr. Woodcroft's principle was new, and he considered very valuable. He had taken out seven licenses, and five of the ships were then building. The blades went for one-eighth inch of a convolution, and there were three blades.

Mr. S. Slaughter said he was a partner in the firm of Stoddart, Slaughter, and Co., in Bristol, ship builders and engineers, and had built two vessels of 120 tons, and one of 130, fitted up with Mr. Woodcroft's "spiral." The former were the fastest boats in Bristol, and after two years' experience, he considered the fastest in the world. He had tried other screws in the vessel before Mr. Woodcroft's, and he greatly preferred the latter. This he considered to be the opinion of ship-builders and engineers.

Captain Smith, the commander of Her Majesty's ship the Rattler, said, that she had been commissioned in 1844. Several screws had been tried on her, and, lastly, that of Mr. Woodcroft. The results had been very good indeed. The following was a memorandum made at the time of the results which it had exhibited:—"I think Mr. Woodcroft's spiral propeller superior to any yet tried in the Rattler. It has less vibration, less fuel is consumed, with fewer revolutions and greater speed; consequently, there is less "slip." On the 25th of February, the result of going with a head wind blowing hard, was better than heretofore." He had never made any comparison fairly between it and Mr. Smith's screw, for the state of the ship was against Mr. Woodcroft's invention; the pitch was from 10 feet 6 inches to 11 feet 2⅜.

Mr. Murray, assistant-engineer to the Admiralty, said that he could speak to two trials, one on the 13th of April last, and the other on the 18th of March, in which the relative merits of Mr. Smith's and Mr. Woodcroft's inventions had been tested. With that of the former the results were as follows:—With the engine giving 26.28 strokes, the rate of speed was 8.18 knots, the slip being 3.143, or 27,758 per cent., and the revolution per minute 104.34. With that of the latter the results were—with the engine giving 24.152 strokes a revolution per minute, a speed of 8.159 knots, and a slip of 2.155, or 23.562 per cent. The result exhibited in Mr. Woodcroft's favour a speed nearly as great, with less power of the engine, and much less slip. If the facts which he had stated were reduced, a difference would be shown of one-sixth of a knot per hour in favour of Mr. Woodcroft. By other experiments Mr. Smith's screw had attained a greater velocity.

The Solicitor-General then addressed the court on behalf of Mr. Smith and the Ship Propelling Company. The question, he said, was whether, on the principles which had been laid down in one or two acts of parliament, a sufficient claim could be made out to the extension of the present patent. For this purpose it was not sufficient for the petitioner to come forward and state, "I have had a patent for 14 years, I have been unable to make anything of it, and I now ask a renewal." It had been laid down by Lord Lyndhurst (in Webster, p. 58,) that there must be a serious case of loss; that the discovery or improvement must be a considerable one, and beneficial to a great extent to the public. He submitted that the present was no case of an useful invention at all. There was nothing new in the idea of using a screw for propelling vessels, as it had been in existence as long ago as 1794. It was Mr. Smith's discovery that the screw should be placed in the centre of the dead wood which first led to its practical utility. When the screw was so placed and reduced to between one-fourth and one-eighth of a convolution all other points with regard to its construction became immaterial. Before Mr. Smith's invention the screw was placed in unsuitable parts of the vessel, and none of them had ever succeeded. The Solicitor-General then proceeded to explain, with reference to the models produced in court, that it was only by adopting Mr. Smith's discovery, and inserting the screw in the dead wood, that Mr. Woodcroft had succeeded in making a practical application of his patent. He read an extract from the specification of the latter gentleman, the strongest point in which was as follows:—"The spiral propeller may also be placed under the stern of the vessel, as seen in figures 5 and 6, where a part of the hull is removed." The improvement claimed by him had nothing to do with the position, but was one in reference to an increasing angle. At the time when Mr. Woodcroft took out his patent it was no improvement at all, for want of the discovery that it should be placed in the dead wood. The claimant here must satisfy them that he was the author of a useful improvement by proof now, and irrespective of the improvements of another man; but it was only by importing into the specification the improvement of Mr. Smith that any beneficial result could be got at. Mr. Carpmael's evidence was merely matter of opinion, and not such as their lordships could rely upon. In the drawings 5 and 6, the modes of using the screws were quite different from that now practised, viz., the introduction of a single screw in the centre line of the dead wood. No particular ratio of angular increase or decrease was claimed by Mr. Woodcroft, and Mr. Commeraux had already discovered the principle. In the patent of the latter the term "spiral" was used, and in the drawing the increasing angle was clearly marked. The convolutions in the drawing were as three to two.

Mr. Carpmael had stated that the spiral would work with any number of convolutions, but notwithstanding the amount of experience on the subject now, not more than one-quarter of a revolution had in any screw been found to answer. After 14 years' opportunity for experiment, it had been so, and the *onus probandi* therefore lay on Mr. Woodcroft, for showing that the spiral would work at more than one revolution. As to the account which had been put in to make out a case of hardship, if there be anything in Lord Lyndhurst's *dictum* that such must be a strong case, what did it come to here? The gentleman who had been called on that subject, had stated facts which had entirely removed the hardship. Did not this lead to the inference that the patent had failed in coming into effect, not from the poverty of the patentee, but from its impracticability without the introduction of another improvement. Deducting the amount of 460*l.* received, or to be received for licences from the total amount of loss, there remained only a sum of 700*l.*, which was not more than the value of a patent. It was impossible to suppose an unsuccessful patent which was not associated with loss, and he saw nothing in the present case which rendered it one of great hardship. He did not think he should call any witnesses with reference to the respective merits of the screw and spiral; and he submitted that the application should be dismissed.

Lord Brougham delivered the judgment. This application was anything but a matter of course, for a strong case of merit must be made out, and an equally clear case of want of benefit sustained. In all cases where there was a disputed right as to patent, and where the validity of the patent might come into question, there were two things to be considered. The first was whether the case to prove the invalidity of the patent was so clear as to remove all ordinary doubt; the second was whether the case was so doubtful that that Court would rather retire from its consideration and not decide it. In the former case they would not grant the extension, because they did not see the merits, and because they would not put the opposing parties to the vexatious process of bringing their *scire facias* in the law courts. But where the matter was doubtful—where conflicting evidence and questions of law equally arose, that Court would not refuse the discretionary power vested in them by Parliament merely because it was also a case in which the validity of the patent was contested. The present case came under the first principle he had stated. There was nothing to make it clear that the patent should not be sustained until they took away the merit of the invention. If the patent turned out to be invalid, it would only be the extension of such a patent for so many years. Now as to the merits in this case there could be no doubt. His Lordship, gave it as his own opinion, on a scientific point, that Mr. Woodcroft's invention was a most ingenious application of mathematical principles to mechanical ends, and he commented on the evidence which had been adduced on the subject. It was not enough to object that the patent had been long in coming into operation, for the steam-engine, and many other discoveries, were open to the same observation. God forbid that he should say it was not a great benefit to society, that men of capital should assist those who had made useful discoveries with their money. All his time, his ingenuity, and his labour had probably been exhausted by Mr. Woodcroft on this work. They had every reason to believe that he would be for the next few years in happier circumstances, and more likely to receive compensation. On the grounds he had stated, their Lordships were of opinion that a period of six years should be given by way of extension to the petitioner. What he had said was without reference to Mr. Smith's invention, which might be a most ingenious one.

## SPECIFICATION OF TWO GAS-HOLDERS FOR ABERDEEN NEW WORKS.

*Erection.*—The two gas-holders to be erected in the tanks which will be prepared for them on the site of the works; but the tanks form separate contracts from this one.

*General dimensions.*—Each of the gas-holders to be sixty feet diameter, and eighteen feet deep; the roof to rise five feet in the centre, and be regularly formed on the top to a radius of ninety-one feet six inches.

*Framing.*—The sides to be framed of angle iron, there being three framing rings inside—one around the top, one in the middle, and another at the lower end. The angle iron of which they are to be composed is to be three inches on the angle each way, and three-eighths of an inch thick; and at four points of the sides of the gas-holders, there are to be uprights of angle iron of the same dimensions as the rings for the sides.

*Ribs and stretchers of roof.*—The roof is to be supported with ribs and stretchers between. These ribs and stretchers to be formed of angle iron, three inches broad from each angle, and three-eighths of an inch thick; and all the ribs and stretchers joined together with palms two and a half inches long, and bolted to the vertical flanch of the rib—each with one screw bolt, half an inch diameter, with proper washers and nuts.

*Covering of plate-iron.*—The sides to be covered with plates of sheet iron, No. 16, Birmingham wire guage, weighing not less than 2.62 per superficial foot.

*Roof.*—The roof to be finished with one plate in the centre, three feet diameter, and three-eighths of an inch thick; and the remainder of the roof covered with plates of No. 14 on the Birmingham wire guage, weighing not less than 3.23 per superficial foot. All the plates, both of the sides and roof, to have an overlap on each other of not less than one inch, and the roof plates to have an overlap on the side ones of not less than one and a quarter inch—the whole rivetted together, both for the roof and sides, with rivets of sufficient length, one-quarter of an inch diameter, placed not less than seven-eighths of an inch distant from centre to centre, with substantial inner heads and proper outer ones, neatly hammered up along with the joinings of the plates, so as to make the whole completely gas-tight. The holes for the rivets to be neatly punched with a machine to a guage as to distance, and parallel and perpendicular to each other through the plates.

*Fastening of angle iron to covering.*—The upright, side, and top rings, and top ribs and stretchers, are to be fastened to the plates of the sides of the roof, with rivets three-eighths of an inch diameter, with sufficient inner heads, and neat and substantially-hammered outer heads, so as to make the whole firm and complete. Each rivet connecting the angle iron with the covering of the sides and roof to be not less than twelve inches apart.

*Upright screw bolts for supporting iron.*—In the middle of the gas-holder there are to be four screw bolts, each eighteen feet long and one inch diameter. These bolts are for supporting the four transverse pieces of timber at the lower end of the gas-holder, and to have proper heads, nuts, and washers, with two cast-iron plates above and below the pieces of timber, eighteen inches diameter and three-quarters of an inch thick. There is also to be a cast-iron plate, one-half inch thick, six inches long, and six inches deep, at each end of the pieces of timber, which is fastened to them with one screw bolt, thirteen and a half inches long, and three-quarters of an inch in diameter, with proper nuts and washers.

*Quality of Iron.*—The whole of the plates and angle iron of the two gas-holders, as before specified, are to be of the best Lowmoor plates; and the rivets, uprights, and screw bolts are to be of the best scrap iron. At the lower end of the gas-holders there are to be four pieces of good Baltic timber, free of shakes or large knots. Each of these pieces of timber are to be joined together in the middle, and supported with cast-iron plates and bolts, as before specified.

*Cast-iron standards for guide-rods and pulleys.*—At four equi-distant points, outside the gas tanks, there are to be, at each of the two gas tanks, four cast-iron standards. Each of these standards are to be bolted into the stone work with four screw bolts, eight feet six inches long, one and a half-inch diameter, with sufficient heads, nuts, washers, and cutters.

*Guide-rods.*—In front of each of the standards for the two gas-holders, there is to be an upright guide-rod; and each guide-rod to be three inches diameter, batted into the stone work at the lower end, and fixed with a nut at the top, and through a snug for receiving it, at the lower end of the standards.

*Friction pulleys.*—At the lower and upper ends of four points of the gas-holder, there are to be four friction pulleys at the top, and four at the bottom. The pulleys are to be of cast iron, properly bored out at the eyes, for receiving steel pins, which will have to be properly turned to fit into the pulleys. The lower pulleys are each to be firmly fixed with two screw bolts to the lower ring, and to the upright standard of angle iron with one screw bolt, and the upper pulleys are also to be fixed with screw bolts into the upper ring, and roof framing of angle iron.

*Quality of cast-iron.*—All the metal of the standards, pulleys, &c. to be of the best No. 2 cast iron; and the bolts for fixing the standards, pulleys, and upright bolts for friction pulleys, to be all of best scrap iron.

*Inlet and exit pipes.*—For each of the gas-holders there are to be a set of exit pipes and a set of inlet pipes, there being altogether four sets of pipes required. These pipes to be ten inches interior diameter, and metal half an inch thick, put together with melted lead and yarn joints. The whole to be laid in their places and jointed; after which, puddling will be put in all round them; but the puddling will be done under a separate contract. These pipes to be of No. 2 cast iron.

*Conditions.*—The whole of the two gas-holders to be made and fitted up in their places in a workman-like manner, agreeably to this specification, and to the entire satisfaction of Alex. Gibb, Civil Engineer, in Aberdeen, or his Assistants; either of whom shall have the power to cause to be altered at the contractor's expense, or made new, if necessary, either after it is finished, or during progress, any part or parts that shall not be performed agreeably to this specification.

*Alterations.*—And the said Alexander Gibb shall have power, at any time, to make any alteration on the specification or plans he may deem necessary; such alterations being added or deducted, as the case may be agreeably to a schedule of prices; but no alteration will be sanctioned or paid for by the New Gas Company, unless the same shall have been duly authorised by an order in writing, signed by Alexander Gibb.

*Arbitration.*—In case any dispute shall arise between the Aberdeen New Gas Company and the parties erecting these gas-holders, the same shall be referred to Alexander Gibb, as arbiter between the parties, and his decision shall be final and binding on them.

*Schedule of prices.—Time for completion.*—Contractors will accompany their offers with a schedule of prices for the regulation of extra works or deductions; also state the time they will require to complete the two gas-holders and erect them, agreeably to this specification and accompanying drawings.

*Payments.*—Contractors will likewise state the periods at which they require payments, it being understood that they will be taken bound, under a penalty of ten per cent., for the due fulfilment of the contract.

*A stamp contract to be entered into.*—A stamp contract to be entered into between the parties; one half of the expense of which to be paid by the New Gas Company, and the other half by the contractor.

*Aberdeen.* Alexr. Gibb.

## Art. XV.—THINGS OF THE DAY.

### FINE ARTS.

*Marbles of Halicarnassus or Boodroom.*—A correspondent of the *Times* announces the arrival at Boodroom, in Asia Minor, the ancient Halicarnassus, of a vessel commissioned to convey to England an addition to the treasures of ancient sculpture which this country already possesses, of the highest interest and value. These ancient marbles have been supposed to form a part of the tomb erected by Artemesia to the memory of her husband Mausolus, an exaggerated account have been circulated respecting them, but a late meeting of the Institute of British Architects, Mr. Tite, the vice-president, made a statement from the chair on the subject, and argued that there was no reason to believe that these sculptures ever formed part of the decorations of the mausoleum erected to Mausolus, King of Caria; nor that they were at all equal in character or beauty to the Elgin marbles, with which some writers had compared them. From all that was known they appeared to have formed portions of a frieze, and were in low relief, about the size of the Elgin friezes, but more in the hard and dry style of the marbles of Ægina. They will form an interesting link in the remains of Greek art deposited in the British Museum. It appears that the attention of the Government was first drawn to the existence of these marbles by an application in 1839 to the then Secretary for Foreign Affairs, Lord Palmerston, in a memorial from the Institute, and a similar statement from the Architectural Society. Lord Palmerston kindly granted an interview to a deputation from the latter society, at which Mr. Tite pointed out to his Lordship all that was then known on the subject; these were principally confined to a slight notice in the second volume of the *Ionian Antiquities*, and a note in the 3rd volume of the *Travels of Dr. Clarke*. The deputation further suggested, that as Admiral Stopford's squadron was then wintering in the Bay of Marmorice, in the immediate neighbourhood, a favourable opportunity existed for overcoming the jealousies of the Turkish Government, and obtaining these interesting fragments for the British Museum. Lord Palmerston interested himself very much in the subject, and undertook to write to Lord Ponsonby and Admiral Stopford on that object. Mr. Tite stated that he believed a firman was obtained from the Sultan at that time, but in consequence of the exertions in Lycia, of a similar nature, by Sir Charles Fellowes, this permission had been overlooked, or perhaps confounded with his labours. By the article in *The Times*, it appears that Sir Stratford Canning has succeeded in obtaining permission from the proper authorities for their removal, and the marbles having being taken out of the walls of the fortress of Boudroom, will probably now soon be placed in the British Museum.

*Romano-British Antiquities.*—Many years ago an exceedingly interesting and curious collection of antiquities was found on Polden Hill, Somersetshire, comprising 83 pieces, consisting of bronze bits of bridles, buckles for harness, rings ornamented with curious projections, bosses of shields, fibulæ, hooks, strigils, hilts of swords, and other interesting objects. Some of these pieces had been inlaid with precious stones and silver, many beautifully engraved, and all of them in the highest state of preservation. The collection fell into the hands of a gentleman distinguished for his antiquarian lore. On the decease of Mr. Anstice, in 1845, his antiquarian collections were forwarded to London for sale by auction, and were dispersed under the hammer of Messrs. Sotheby and Co., on Monday last, when these Romano-British antiquities produced 100 guineas, having been purchased, we believe, for the British Museum. Among other objects in the sale was a portrait of Charles I., embroidered, we understand, by his daughter during their confinement in Carisbrook Castle. This lot was purchased by Mr. Hertz, the well-known antiquary, of Great Marlborough-street, for 15*l.*

*The Fitzwilliam Museum.*—The Fitzwilliam Syndicate have reported to the Senate that, in conformity with the grace of December 15, 1845, they obtained from Mr. Cockerell designs for the completion of the hall and staircases of the Fitzwilliam Museum, for which parts of the building Mr. Basevi had not left designs in a settled form; and they expressed their entire concurrence with Mr. Cockerell's views as to the mode of finishing this part of the museum. "The Syndicate recommend that he be requested to prepare working drawings and estimates corresponding with his designs, with a view to a contract being made for the execution of the work."

*Statues of the Pont du Carousel, at Paris.*—The four colossal statues by Professor Petitot for the four corners of the Pont du Carousel, in Paris, are now finished. They are all setting figures, and severally represent the city of Paris, the Seine, Plenty, and Industry. Paris wears her mural crown,—is seated in a vessel, to indicate her origin,—has the *bâton* of command in her right hand,—and leans with her left on a sword. The Seine is represented as a nymph, sitting by her urn,—and with an oar in her hand. Industry has the hammer in her hand, and her foot upon a wheel;—and Plenty has a horn, filled with the fruits of various lands, suspended from her arm, and on her knees a case, filled with jewels—her feet rest on rich and luxurious cushions, and by her side are a lyre, rolls of paper, a palette and pencils,—as representatives of the Arts which follow in her train.

*Summary.*—The Select Committee appointed to consider the objects, results, and present position of Art Unions, and the most expedient means of placing them on a safe and permanent basis, have just published their Report, extending to 530 pages. After describing the origin and progress of the several associations of this kind which have arisen out of the London Art Union, and supplying statistics of their receipts and expenditure, the Committee proceed to deduce from the very conflicting evidence which has been brought before them, the opinions which form the most interesting feature of their report. The witnesses combat the objections which have been made to the effect of such assocations on art.—A medal in honour of Count Mole is about to be struck at the French Mint, by M. Caunois; presenting merely the profile and name of the statesman on one side, and on the reverse recording him as having been a Peer, Minister, and Academician.—There have just been placed in one of the salles of the Louvre, several antique fragments from Greece. Among them are a bas-relief, representing Thesus as the protective hero of Attica; a bas-relief, with the Nine Muses between Mercury and Apollo; and another from Crete, containing a figure of Jupiter, seated between Europa and Cadmus, both highly venerated in that island. There are also some marbles from Asia Minor, one of which, from the town of Mylasa, in Caria, is exceedingly important, as it contains three decrees of the reigns of Artaxerxes II., Mnemon, and Artaxerxes III. These decrees are well known to savans.—The death of Le Chevalier Renoux at Paris is announced in the Paris journals: he was the painter of the beautiful pictures now exhibiting at the Diorama, in Regent's Park.—The Institute of British Architects have awarded their medals for 1845 to Mr. T. Worthington, of Manchester, for the best essay on the history and making of bricks; to Mr. S. J. Nicholl for the next best essay on the same; and to Mr. Wadmore for a design for a royal chapel.—It is now announced that the meeting of the Archæological Institute at York, is fixed to commence on Tuesday, July 21, and not in June, as originally proposed; so that this assemblage will anticipate the Archæological Association meeting at Gloucester by about a week.—The Chapel at Carthage, commemorating the landing of the French King in Africa, has been completed. Mr. Charles Jourdain, architect to the King of the French, at Tunis, is the architect. The chapel is erected in the Gothic style, and is connected with the other buildings by colonnades. They comprise the dwelling of the priest, vestry, a hall of reception for strangers, &c. The whole is encompassed by a wall.—The great west window of Leominster parish church is about to be restored. This window has 41 feet clear glass in height, and about 25 feet in width. Mr. T. Nicholson, architect of Hereford, is appointed to superintend its restoration.—The French Academy of Arts at Athens will receive every year a certain number of pupils of the *French Academy* at Rome, who will thus be enabled to study in succession the monuments of Greece. The Government will, moreover, appoint a Paris professor of fine arts, to remain three years at Athens, to direct the studies of the pupils, as has been hitherto the case with the French school of art at Rome.—The Marquis of Northampton lately exhibited at the Archæological Institute a specimen of glass, of the same manufacture as the Portland Vase, ornamented with white figures' relieved on a blue ground, and formed like a cameo by cutting away the upper surface.—The restoration of the ancient monuments in St. Martin' Church, Birmingham, is completed. The most ancient of them is the crossed legged effigy of a knight in armour, over which is a loose surcoat, or linen frock, bearing a shield on his left arm, charged with a "bend lozenge." This is believed to represent Sir William de Birmingham, who died in the latter part of the reign of Edward the First, as he bore for his arms the bend lozenge. The effigy is placed on a new altar-tomb, from a design by Mr. M. H. Bloxam.—A numerous syndicate has been appointed at Cambridge to consider whether, with a view of carrying into effect the design of a new botanic garden, it be expedient to impose a tax upon members of the University; and if so, in what manner such a tax may most conveniently be imposed, and to report to the senate before the division of next Easter Term.—At the Decorative Art Society a paper was recently read by Mr. Dwyer, 'On the Development of Style.' He contended that the difference between the works of the ancients and moderns arose from a more immediate attention to natural types by the former. Several portions of Egyptian, Greek, and Roman Decorative Art derived from vegetable and animal forms were enumerated; allusion was also made to the symbolical meaning with which most ornaments had been invested, and which, it was argued, ought to be more regarded in the adoption for modern purposes. Mr. Dwyer exhibited chalk drawings, one of a capital to a column, designed by himself, from the water-cress,—others which illustrated in a variety of graceful lines, the beautiful forms which the congelations on our windows assume in frosty weather; and one, of the common nettle in blossom, in an inverted position, as affording a type for a chandelier. He did not advocate servility in copying natural products, but contended that ideality ought to imbue all designs for embellishments. He especially desired to see in our schools for artists copies from ancient works beside the natural archetype from which they were designed, so that the ideal might be more correctly appreciated. He concluded with some remarks upon geometry and proportion as being essential to the best arrangements of the best ideas. The Duncombe Testimonial has been completed, and now lies for public inspection at the Parthenium Rooms, St. Martin's Lane.

CONSTRUCTION.

*New Barracks at Woolwich.*—The Board of Ordnance having given notice to the Admiralty that the west square of the Royal Artillary Barracks, at present occupied by the Woolwich division of Royal Marines, will be shortly required for the accommodation of the 10th battalion, about to be raised, and the numerous recruits for the Royal Artillery almost daily joining at head-quarters, the works at the new Royal Marine Barracks have been ordered to be expedited for the reception of the corps. The whole of the brick-work of the extensive new Royal Marine Barracks, capable of accommodating upwards of 1,000 men, with residences for their officers, has been erected, and it is expected will be fully completed within two months. The basement story will be occupied as kitchens for cooking, and contain large iron ranges, with every convenience for the purpose. The floors are formed of large flag stones adjoining the fire-places, and the other parts of asphalte on a concrete foundation. To prevent fire the joists are of metal, and the only parts made of wood are the window sashes and steps leading to the first and second stories. The floors of the first and second stories are formed of asphalte on concrete foundations, placed upon brick arches, and there are no fire-places in the apartments above the basement story, the whole of them being heated by an apparatus for circulating hot air, which is effected by means of an Archimedean-screw eight feet in diameter. The motive power for working the screw is attained by weights, on the same principle as an eight-day clock, which when wound up will cause the screw to revolve with great velocity for eight hours. In front of the first and second floors a large open space, the entire extent of the building, has been constructed and arched over for the men to take exercise in wet weather, and every care has been taken for their comfort. On the north side of the barracks for the men substantial and commodious dwelling houses have been built for the colonel in command, and the colonel second in command, and for officers' quarters. In a line with the barracks for the men the staff non-commissioned officers' quarters have been constructed, and a spacious room for a library and a piece of ground set apart for a racquet-court. On the south side is the mess-room and ante-rooms, with dwelling houses for officers' quarters. The ground in front of the barracks for the men is in progress of being levelled, as it will be required for drill before the contractor can finish the outbuildings and boundary walls.

*Turkish Plaster.*—The impervious and adhesive qualities of this composition, which is remarkably simple and durable, are so efficacious, that although some tanks are entirely beneath the earth, and thus perpetually exposed to outward infiltrations as well as inward pressure, and undoubtedly coeval with the earliest Byzantine monarchs, yet there is no record of their requiring repair, or of their having ever leaked. Water-pipes of burned clay or metal, joined and coated with it, resist the effects of humidity for ages. The following is the receipt, as now used:—Take 100lbs. of fresh kilned lime, finest quality, reduced to powder; ten quarts of pure linseed oil; and one or two ounces of cotton. Manipulate the lime, gradually mixing the oil and cotton in a wooden trough, until the mixture assumes the consistence of loaf-dough. Let it dry, and then break it into cakes for store or use. When required for use, take a sufficient quantity, moisten it with linseed oil, and with this paste give two or more coatings to the walls or pipes, allowing each coat to dry. Pipes of metal or clay can be hermetically jointed by twisting well-carded hemp, saturated with plaster, round the interstices, and making it fast with cord also dipped in the mixture.

*Khorassan or Turkish Mortar.*—Khorassan is used for the construction of mosques, reservoirs, and other buildings requiring extraordinary solidity. It is composed of one-third bricks and tiles, pounded to the consistency of road-scrapings, and two-thirds of finely-sifted lime, with the necessary quantity of rain-water. When employed, the mortar is laid on in layers of from five to six inches in thickness between each range of bricks or stones, the latter being dipped or sprinkled with water to augment the adhesion. Khorassan, still in common use, was employed by the early Byzantines, as is proved by the remnants of their churches and cisterns. It was borrowed from the Arabs, who took it from the Persians, and called it Dakik el Kerf, or Potter's Dust.

*Form of Curb Stones.*—A correspondent of the *Builder* suggests, that instead of placing the channel for carrying off the water in crowded streets outside the curb stone, whereby the passengers on the foot-way are bespattered by any passing vehicle, it would be preferable to hollow out the curb stone sideways, so to afford a passage for the water within it. The passage for the water would then be covered over on the top, and open on the side next the street. By this arrangement, which is adopted in Paris, the wheel of a cart or omnibus could not travel in a gutter, as the access of both wheel and hoof would be prevented by the overhanging top. Curb stones of cast-iron could easily be made in the manner suggested.

*New Bridge across the Thames.*—The bills for the park and embankment at Battersea are, it appears, about to be accompanied by one for a bridge to cross the river between the Red House and Chelsea Hospital,—communicating with the Middlesex part of the capital by the line of Sloane Street. A further measure involving extensive powers, vested in the Commissioners of Woods and Forests, will enable them to erect on the Surrey side of the river a succession of villas, crescents, squares, and streets, in execution of certain parts of the Report of the Commissioners.

*Summary*—The Barentin Viaduct which lately fell is being reconstructed with great activity. Seven or eight hundred labourers have been occupied during the last month in clearing away the wreck, and the new scaffolding is about ready.—At Berlin one of the gasometers of the English gas company has lately burst: it had just been imported from England.—The first stone of the Skew-bridge, over the grand canal at Monasterevan, on the Great Southern and Western line, was laid last month.—The Railway communication between Vienna and Prague has been interrupted by the falling in of a viaduct, which calamity is ascribed to the too great haste and precepitation with which this line has been constructed.—The *Pont de la Tournelle*, at Paris, is about to be widened, by causing the foot-ways to project over, and supporting them by cast-iron arches resting on the piers.—The Lowestoft Harbour Commissioners are about to enclose 16 acres in a treble row of piles, to extend about 1,700 feet from the bridge towards the sea, and to project into the ocean about 1,200 feet from the present water mark. Between this piling, which will be strongly braced, will be laid Whitby stone, the weight of no piece used to be less than three tons. The whole is to be an oblong square, and on the top is to be a promenade and platform 25 feet wide, which will form jetties into the sea, and the entrance for vessels will be at the south-eastern corner, a space being left for this purpose about 200 feet wide. Within this piling the sea is not to be met by a perpendicular wall, but by a slanting bank somewhat in the form of a sea bank, called the clay puddle. By these means it is expected that the bar will be entirely got rid of.—Two of the five contracts on the Leeds and Thirsk line, which were let to Mr. James Bray, are being prosecuted by him with great energy. The shafts required for the tunnel in the Bramhope contract have all been commenced, and at those which have been carried down to the level of the railway, the driftway is in progress, and is being carried on night and day.—The Lytham station of the Preston and Wyre Railway, erected by Messrs. Towers and Westall, of Fleetwood, from designs and under the superintendence of Mr. B. B. Rampling, presents a façade in the Roman Doric style, constructed entirely of Longridge stone. It consists of a circular vestibule, about 18 feet in diameter, surrounded by pilasters supporting a deeply-coffered dome, with stained glass dome-lights. On the right hand is a general waiting room and the departure platform; on the left is a waiting room for ladies, and the arrival platform. The carriage station is 140 feet long by 53 feet wide, and is covered by a roof which consists of twelve arches of timber, put together in segments, and secured by nuts and screws: all the timber ends butting upon each other like the stones of an arch.—The four measures by the Government for the improvement of Ireland have now become Acts of Parliament, and at this moment there is 250,000*l.* available for the purposes therein declared. The Acts of Parliament now in force are four in number; they relate to public works, drainage, harbours and piers, and county works presentments. Under the first three 150,000*l.* is to be advanced, and under the fourth the sum of 100,000*l.*, making 250,000*l.* at once available for work and food on account of the failure of the potato crop. Whatever may be the result of these measures, whether their objects may be abused, or their spirit perverted, they will appear as the first statutes passed in 1846 wherein an honest endeavour was made to remove the fear of want.—The *Tralee Chronicle* says that the Earl of Kenmare has given 300*l.* to Mr. Townsend, of the Christian brotherhood in Killarney, towards the erection of the monastery in the vicinity of the new cathedral, on the express condition that the work should commence at once, so as to afford immediate employment to the people.—The Liverpool Town Council and Dock Committee have decided upon completing immediately the Albert Dock Warehouses, and to enable them so to do, they will introduce a Bill during the present session of Parliament.—The authorities of Birmingham contemplate the erection of certain new municipal buildings.—At Manchester 4,000 men connected with the building trades have struck, partly for advance of wages, and partly for an abridgment of the hours of labour. The masters have formed themselves into an association to resist the demands.—The Ely and Peterborough line is now in rapid progress, and will be opened during the ensuing summer, probably in June. The contractors are Messrs. Grissell and Peto, who employ upon the line 3,400 men, 700 waggons, 286 horses, and 4 locomotives.—The differences between Mr. Barry and Dr. Reid at the Houses of Parliament have had the effect of delaying the works in the House of Lords for some time past, and very probably will do so for some time to come.—At a late meeting of the Geographical Society a paper was read by Lieut. Spratt, R.N. entitled 'Remarks on the Isthmus of Mount Athos and the Canal of Xerxes. This canal was excavated by the Persian Monarch in order to avoid the danger to his fleet of rounding the promontory of Mount Athos. That such a work was ever undertaken has been doubted, and the veracity of Herodotus on this subject has been disputed. But the testimony of Choiseuil Gouffier, Dr. Hunt, and Colonel Leake, and the late examination by Mr. Spratt, place the matter at rest. From the subject of the canal itself, Lieut. Spratt proceeds to speak of the cities of Sane and Uranopolis, which were in its neighbourhood, and the ruins of which he discovered. A mound is also mentioned, which is conjectured to be the tomb erected by Xerxes in honor of Artachæus, the chief director of the canal.

RAILWAYS.

*Magneto-Atmospheric Railway.*—About fifteen months ago we threw out the suggestion in the *Artizan* that the tube piston of an atmospheric railway might be connected with the train by means of magnetism. Since that time the same project has been brought forward in various shapes, and we believe some patents have been taken out for it, but in most of the arrangements the faults of detail have been such as would be fatal to even a less precarious method of attachment. One of these plans is thus described, "Fixed to this carriage will be several large bent-iron bars, capable of being converted into magnets of an attractive power of many tons. These bars, prepared with the coating of copper wire, will descend to within a very short distance of the upper part of the tube. The piston in the tube is furnished with bars of iron, which ascend and almost touch the thin copper in place of the valve, and the magnets above, and the iron bars on the piston below are separated only by a distance of perhaps three-fourths of an inch." An intelligent correspondent of the *Mining Journal* objects in reference to this arrangement, that the tendency in the magnets of the carriage, and the bars of the piston, to approach each other, must produce a degree of adhesion of the carriage to the rails, and of the piston to the internal and upper surface of the tube, which would entail a ruinous amount of friction, and as a remedy for the defect proposes, that the magnetic attraction should be made to act in a horizontal, instead of a vertical direction, by causing the iron bars within the piston to cross its horizontal diameter, placing the horse-shoe magnets so as to embrace the upper half of the tube. The objection is certainly sound, and the remedy suggested appears to be judicious. We do not, however, expect that atmospheric railways, with a piston in a pipe, will ever come into extended use, whatever be the mode of attachment.

*Railway Bridge over the Tyne.*—A cast iron bridge is about to be erected over the Tyne, at Newcastle, from the designs of Mr. Robert Stephenson, which will present many points of novelty in the construction. It will consist of six arches, and will extend from the Castle Garth to the high ground on the south side of the river. There will be two roadways, one on a level with the Castle Garth for carriages and foot passengers, and the other at an elevation of 22 feet above it, with three lines of railway, for locomotives. The carriage road will be 1,380 feet in length, on a straight line, and the locomotive way will be immediately above, with the exception of a space at each end, the locomotive line diverging at a point about 270 feet from each end to the west on the north side, to run into the general station to be built at the Forth, and to the east on the south side, to form a junction with the main line southward. These diverging portions of the locomotive way will be supported on handsome colonnades, each consisting of 20 metal pillars. The bridge itself will consist of six river arches, with four land arches on each side, the former 124 feet 10 inches, and the latter 36 feet 3 inches span, the land arches diminishing in altitude from the foundation upwards, corresponding with the excess banks of the river basin. These arches will be supported on piers of solid stone masonry, and will be constructed of cast iron. The piers will be 48 feet by 16 feet 6 inches in thickness, and in extreme height about 181 from the foundation, having an opening in the centre through each, so that, to the spectator at a distance, the bridge will appear to rest on pillars, and will present nothing of that massive character which might be expected in a structure of such gigantic proportions. These piers will be built on piles piercing the bed of the river about 50 feet on the north side, and about 20 feet on the south side. The roadway for carriages and foot passengers will be 35 feet above the level of high water mark, suspended by rods from cast iron arches, springing from the piers at the carriage road level, and the railroad will rest on the crown of these arches. The carriage way will occupy the centre of the lower bridge, being 20 feet wide, and it will be separated from the footpath on each side by a row of light metal pillars, the footpaths being each six feet wide, with handsome balustrading on the outside, about 4 feet high. The locomotive way will be protected by a similar row of balustrading, and the whole of this part of the bridge will be constructed of cast iron. The approaches to the carriage road and footpaths will be through a grand triumphal entrance on each side of the river, in three arches, which will be surmounted by a statue, at the north side of the river, which will represent Mr. George Stephenson, the eminent engineer.

*Movement respecting Railway Deposits.*—A public meeting has been held in Glasgow for the purpose of adopting such resolutions as might be considered expedient to obtain the postponement or withdrawal of the great mass of railway projects now seeking their bills in Parliament. The feeling of this meeting was unanimous. The persons who spoke on the occasion admitted to the fullest extent the advantage of railways to the country, and the impropriety, in most cases, of restricting the spirit of enterprise; but they also declared that the diversion of capital into this one channel would seriously endanger the commercial and agricultural interest of the country, and that the call for so many additional millions as the projected railways would require could not be made without causing serious embarassment. The resolutions, which were passed without a dissentient voice, were to the effect that the Government should be addressed on the subject.

*Summary.*—At a recent meeting of the Trent Valley Railway Company, at Manchester, Mr. Edward Tootal announced the intention of the directors of the amalgamated companies to have a telegraph lai down immediately from London to Liverpool, and from London to Manchester.—The number of passengers who have travelled on the Great Western line since its opening on the 4th of June, 1838, to the 31st of last December, amounts to 10,904,605. In 1838 the number was 264,644; in 1839, 606,396; in 1840, 1,024,217; in 1841, 1,541,656; in 1842, 1,606,015; in 1843, 1,629,150; in 1844, 1,791,272; in 1845, 2,441,255.—Mr. Carnegie at a meeting of the Cork and Bandon Railway lately held, instanced an extravagant demand for compensation. Five thousand pounds was claimed for 2½ acres, whilst the whole farm was worth only 2,500*l*. At the same meeting Mr. Smith spoke of one who wanted compensation for the injury which would be done to the *milk of his cows* by reason of the noise, steam, and smoke of the locomotives in their transit.—The Court of Common Council has determined upon petitioning parliament against the North Kent Railway Bill, The company propose to carry their line into the city over Southwark-bridge, and to erect a terminus at the end of Maiden-lane. Mr. Lott referred the court to the mass of deformity called into existence by the Blackwall Railway Company through allowing them to enter the city, and a expressed a hope that every attempt to increase this evil would meet with a firm and powerful opposition.—The letters from Bombay describe the railways as advancing in favour with the Indian public. The line of the East India Railway had been gone over by Mr. Simms, and, it is said, had proved satisfactory; it was still being surveyed at the date of the letters. Mr. Clarke and Mr. Conybeare, the engineers of the Great Indian Peninsular Company, were busily engaged in selecting their lines. That through Salsette, across the Koukan, and over the Malseghi Ghat, to a place called Alla, about thirty miles beyond the Ghaut, had been carefully examined, and found practicable and economical, as also the first part of the extension northwards, above the Ghaut towards Khandish, the commencement of the proposed branch to Malwa and Oomrawatta. These were regarded as the most difficult portions of the lines.—The *Cork Examiner* states, that one of the highest authorities in the country has given it as his opinion, that the Society for the Improvement of Ireland will, by judicious action, obtain from government 3,000,000*l*. for completing Irish railways.—Mr. Samuda in a report to the Directors of the London, Croydon, and Epsom Atmospheric Railway says, the facilities of managing the apparatus—regulating the speed of the trains—obtaining the power—exchanging the trains from locomotive to atmospheric traction—working a single atmospheric line in conjunction with and in continuation of a double locomotive railway—have now practically been demonstrated to be in all cases equal to his expectations, and in some have surpasssed the anticipations to which he gave expression. We hear bad accounts of the engines for maintaining the vacuum, which it appears are breaking very often. There is too much cast iron about them, and they are not strong enough for high pressed steam.—Mr. Chadwick in a pamphlet just published, " On the Moral and Physical Evils in Connection with Railway Works," says, that the number of labouring men that were killed or wounded in the construction of the summit tunnel on the Sheffield and Manchester line equals the proportionate casualties of a campaign or a severe battle. The losses in this work were more than 3 per cent. of killed and 14 per cent. of wounded, while the deaths in four of our principal battles amounted to only 2.11 per cent. of privates.—A report presented to the Minister of Public Works in France by Inspector Mallet, who was appointed to examine the atmospheric railroads in England, contains a detailed statement of the comparative expense of the construction of an ordinary railroad, served by locomotives, and of one on the atmospheric principle. It appears according to M. Mallet's estimate that for one kilometre of either system, the total amount is precisely the same, viz., 307,000 francs, the only difference is in the number and relative amounts of the items. We have no faith, however, in these deductions.—It appears from the official report presented by the special commissioner of the Lyons and St. Etienne Railroad to the prefect of the department, that the number of persons killed by the accident of the 1st inst., or who have since died, is 18, and the number of wounded, 48. A rigid judicial inquiry is going on as to the causes and circumstances connected with this catastrophe.—The King of Holland has granted the concession of a railway from Maestricht to Aix-la-Chapelle, with two branches, one towards the coal mines of Kohischad, and the other towards Karkrade.—The Eastern Counties Line appears to be badly managed, and complaints pour in from all sides of the irregularities, disasters and confusion which prevail in every department. Never was there a line in such universal bad odour. Every day is marked by delays of mor e or less time, and the time-table is regarded as the most ingenious fiction which the monthly press produces. The appointment of Mr. Hudson to the office of chairman appears to have done but little good, but the irregularities have risen to such a pitch that it is rumoured that Mr. Hudson can stand them no longer, and threatens retirement from the board of directors. We are unaware whether any greater calamity than those we have already experienced would result from this event, but we humbly conceive that if the honourable gentleman would exercise his powers to remedy the evils, instead of giving up the matter in a pet, it would be the better course.

### ENGINEERING.

*French Steamers to the West Indies.*—MM. Delahaute, Boikett and Co., are said to have proposed to the French Government to establish a line of steam-boats between France and the continent of America, to sail from the following ports twice a month:—From Havre to New York; from Nantes to Madeira, the West Indies, and the Spanish Main; from Bordeaux to the Azores, the Havannah, New Orleans, Galveston, and Mexico; from Marseilles to the Canary Islands, the Cape Verde Islands, all the ports of the Brazils to the south of the line, and La Plate (Monte Video and Buenos Ayres). The steam-boat from Havre to New York to take in passengers at Portsmouth or the Isle of Wight; the boat from Nantes to take passengers at Vigo and Lisbon; and the boat from Marseilles to touch at Barcelona, Mahon, the north coast of Africa, Cadiz, and Lisbon. The establishment of this line of packets will require a capital of 50,000,000f., and MM. Delahaute, Boikett, and Co. are ready to undertake the contract on receiving a lease of 46 years and 324 days. They further require, should the concern not pay 3 per cent. on the capital, that the Government should supply the deficiency; and, on the contrary, should the concern pay more than 10 per cent., the contractors are willing to divide the overplus with the Government.

*Steam to India via Trieste.*—The German Governments seem to be becoming fully alive to the benefits the opening of a railway communication from Ostend to Trieste will confer upon them. The *Cologne Gazette* states that an agent of the Austrian Lloyds Association had just been at Carlsruke, and had concluded an agreement with the railway company there, by virtue of which a special engine will be laid on the line for the further conveyance of the Indian mail-bag from Bruchsal to Manheim at all times, and he found that the German authorities made the most ready advances towards him. The same agent has made similar agreements with the directors of the Belgian railroads, the Aix-la-Chapelle and Cologne line, and the Rhenish Steam Packet Conveyance Company. From thence his route lay through Wurtemberg and Bavaria back to Trieste. The Indian mail will now go regularly through Germany every three weeks. For the sake of experiment, however, the Marseilles route will still remain in use for some time longer. The Indian mail-bag contains every time about 40,000 letters, which, together with the newspapers, make a total weight of 50 cwt. For the transport of this heavy burden three baggage waggons are requisite, for which at every station which has still no steam power at its command, fourteen horses must be kept in readiness. Important as this channel of connexion may already appear, its importance is still further increased by the fact that the conveyance of travellers and finer goods will be made in the same direction. A serious competition on the part of France is the less to be feared, as the Offenburg and Constance line through the Kinzig valley will soon be opened; the Breganza and Verona line will next be called into existence. From Verona to Vicenza it is being rapidly constructed, and thence to Venice the line is already in operation.

*The Steam Frigate Terrible.*—This vessel is now ready for sea, and has been tried down the river with satisfactory results. On reaching the measured miles in Long-reach, her speed was timed, and she was found to accomplish the mile in five minutes thirty-four seconds, or at the rate of 11·778 miles per hour. The knot was run in six minutes twenty-eight seconds, or at the rate of 9·288 knots per hour, the engine making thirteen and half revolutions per minute, with an eight feet stroke. When the vessel arrived opposite Sheerness, the engines were making fourteen to fourteen and half revolutions per minute. The speed was then tried by two of Massey's logs, one from each paddle box, and found to be, by one log with and against the tide, 10.92 and 10.95 knots; and with the other, 10.9 and 10.8 knots per hour. The engines during her progress worked, and her motion through the water is steady, and free from vibration. The *Terrible* has on board the whole of her guns, two 8-inch and two 56-pounder long guns of 98 cwt. each, on traversing platforms, on her fore upper, and the same number and calibre on her lower fore deck, and two 8-inch and two 56-pounder guns, on traversing platforms, on her upper, and the same number on her lower stern decks, with two 12-pounder carronades and one 6-pound brass gun on her upper fore-deck. On the lower stern deck are racks for muskets and pistols, and she appears well appointed with shot and shells, and all the requisite munitions of a powerful war steamer. The engines of the *Terrible* are by Messrs. Maudslay and Field: they are on the double cylinder plan, of which we have spoken on various occasions. The engines are fitted with lubricators, and the boilers with brine pumps and refrigerators. The machinery is in every respect the same as that of the *Retribution.* The practice of giving appaling names to the steamers of the Royal Navy seems to bear some affinity to the war cries and hideous masks whereby savages seek to intimidate their enemies. It reminds us of the name given by the Glaswegians to a dredging machine by which they expected to deepen the Clyde, so that no shipping should thenceforth remain at the lower ports, and with the view of exulting over their chief rivals they gave the machine the sounding title of "The Terror of Greenock."

### MISCELLANEA.

Mr. R. Hunt, of Falmouth, who has so well distinguished himself in photographic researches, has lately instanced an experiment, which seems to prove that metallic precipitation is influenced by the magnetic currents—a globule of mercury, in a glass dish, is placed over the poles of a magnet, the mercury being midway; the dish being supplied with a solution of nitrate of silver, it is found that the arborescent precipitate of silver exhibits a tendency to ramify in the direction of the magnetic curves formed by the currents of magnetism. Mr. Murray, of Hull, claims the priority of the discovery, and says, that he was the first individual who ever made experiments of this description. These experiments were, at the time, communicated to the late eminent traveller, Dr. E. D. Clarke, of Cambridge, and, by him made known to Dr. Ure. Both magnetic bars, and those of a horse-shoe form, were introduced into solutions of nitrate of silver and bichloride of mercury; and the silver crystalline lamina in the former, and the mercurial globules in the latter, were invariably found to be most abundant at the edges and angles of the magnet, and that in the ratio of the relative magnetic power, and with a visible curvature in the direction of the magnetic currents.—The superabundant capital of that realm has been, of late, largely devoted to the structures of dykes, for the sake of increasing the quantity of cultivatable land. Of the *Zuider Zee* it is now nearly ascertained, that it formed, in times long gone by, part of the land, with embouchures of some rivers on it, to which its old appellations of *Vlie* and *Vlieland* seem to point. Besides the great dyke-works to be undertaken on the Waart and Graetgründe—the government has now authorized the extensive works at Harderwyk, by which a great gaining of land, and the deepening and repair of the harbour, will be combined. A new contrivance has been resorted to in these operations—called *Aanslibbing.* It is known, that the high tide carries with it a quantity of fertile soil (called *slib*), which on being prevented from receding with the low tide, becomes accumulated, and thus, those very same powers of the ocean which destroyed these shore ages ago, are now forced by art to contribute to its reconstruction.—At a late meeting of the Horticultural Society, there were distributed some seeds of the Brassica Chinensis, or Shanghai oil plant, sent over by Mr. Fortune, from China. This is a plant of the cabbage tribe, which yields oil by expression, and a large quantity has been sent over to this country for experimental trials.—A short time since, a meteor, which commenced in the Canton of Pierre, in La Bresse-Loubannaise, after having passed over a space of two leagues, fell on a farm-house in the village of Lachaux, and burnt it down, with all the cattle and produce of the last harvest.—A German writer has recently proposed that when a foreign body, such as a particle of straw, dust, &c., gets between the eyelids and globe of the eye, but without being infracted, a solution of gum arabic dropped into the eye, may be advantageously employed for its extraction, as the solution does not produce any disagreeable sensation.—The *Frankfort Gazette des Postes* states that an unpublished work of Linnæus has been discovered in Sweden after having been long sought in vain. It is entitled the *Nemesis Divina.* In this labour of the last years of his life the great naturalist recorded, for the instruction of his son, a number of observations and facts, deduced, in a great measure, from the private life of the persons with whom he was acquainted, in order to demonstrate that Divine justice punishes and rewards even in this world.—By the advices lately received from Brazil it appears that a discovery has been made in the Cocaes Mine by a negro in the employ of the National Brazilian Company. This is a vein twelve fathoms wide, and traced to a length of thirty-seven fathoms. It consists of "jacotinga," containing gold in grains, from the minutest particles to the size of a barley-corn.—Letters from Berlin mention that the Baron de Hackewitz, who has an establishment there at which the electrotype process is conducted on a large scale, has found the means of manufacturing guns and mortars of any calibre by that process, and that a commission appointed by the Minister at War, with the Baron Alexandre de Humboldt at its head, to examine the invention, has made such a report as has induced the Government to purchase the secret for 6,000*l.*—Messrs. Rostand and Co. of Marseilles are about establishing a line of packets to Constantinople and Smyrna: they have already launched three vessels, one of which is called Orontes. There is also a probability of another line being undertaken to Alexandretta, and along the coast of Syria to Beyrout and Jaffa.—The Minister of Marine in Paris closed a contract for 2,000,000 lbs. of English rock coal, to be delivered at the Island of Martinique, at the rate of 4s. 2d. the 2 cwts. The highest price asked was 5s. 10d. It is expected that some extensive contracts will be entered into, during the present year, by the Minister of Marine and Colonies for British coal; and a great competition is likely to take place between Messrs. Jackson of London, and the Newcastle contractors, with those of Havre, Nantes, and Bordeaux, who are all striving to outdo the English in the contract market.—Faber's mechanical man now exhibiting in America, repeats the names of all the states and territories, even such as Mississippi, Alabama, and Virginia, so that they are heard clearly and fully in every part of the room. So also the names of the principal European cities. The word "Philadelphia" is pronounced almost as plainly as it could be uttered by a human being. Tunes are sung by the automaton, some passages of which is said to be given in a truly admirable manner.

# THE SOCIETY

FOR THE ENCOURAGEMENT OF

# ARTS, MANUFACTURES, AND COMMERCE.

**President,**

HIS ROYAL HIGHNESS PRINCE ALBERT, D.C.L. F.R.S. &c.

## LIST OF SPECIAL PREMIUMS: Session 92nd, 1846.

UNDER the New Rules and Regulations, which have been adopted by the Society during the present Session, for the renovation of the working constitution of the Society and the more efficient promotion of its objects, the Council have recommended, and the Society has adopted, the following list of Premiums, approved by the Special Committees of the different Sections of the Society, and they are now offered for public competition :—

I.

## In the SECTIONS of AGRICULTURE and CHEMISTRY.

A PRIZE OF ONE HUNDRED GUINEAS,
For the Invention of a mixture of materials for a wholesome, nutritious, and palatable Bread, to be sold at a low price and used as an economical substitute for wheaten bread, biscuit, or potatoes. The materials suggested are sago, rye, wheat, maize, barley, beans, peas, oats, rice, beet-root, parsnips, &c. To be given in on or before the 15th of April, 1846.

II.

## In the SECTION of FINE ARTS.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For the Model of an Earthenware Jug, in one colour, to contain a Quart, with a Cover.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For the Model of an Earthenware Mug, in one colour, to contain a Pint, without a Cover.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For the Design or Model of the Cover of a Bible, 9½ inches by 12, to be executed in relief, in raised leather or in wood, either by the new process of burning or by the carving machine.

A PRIZE OF FIFTEEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For a Water-Colour Drawing, 8½ inches by 12 inches, of a Holy Family, suitable for engraving in wood, and specially prepared for printing in colours by wood blocks ;—the object being to produce, at a cheap rate, a good picture, which may find its way into humble dwellings.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For a small Geometrical Pattern for a cheap Kidderminster Carpet and Stamped Drugget.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For the cheapest and most beautiful pattern of Mosaic or Tile Flooring, one yard square.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For a Design of the most convenient, elegant, and cheap Washing-stand, Basin, and Ewer.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For the Model of a Tea Urn of a small size.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For Models of a plain and cheap Earthenware Tea Service, in one colour, consisting of Tea-pot, Basin, Milk-jug, Cup and Saucer, and Plate.

III.

## In the SECTION of MECHANICS and MECHANICAL ARTS.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For a simple and good method of applying Steam Power, directly, to propelling Vessels by the Screw.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For an improved Meter, applicable to measuring the quantity or volume of liquids passing through pipes under pressure on both sides.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For an improved Landing Pier, for embarking and landing Passengers, &c. by Steam-boats on Tidal Rivers.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For a portable and compact Machine for Raising and Lowering Heavy Articles from Carts while standing on the streets.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For a Horse Shoe, adapted to the several kinds of pavement now in use.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For an Improved Method of Preventing the Emission of Noxious Vapours from the Gratings of Sewers; which shall permit a free passage of the sewerage, and provide against bursting the drains.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For effective Ventilation of Ordinary Rooms, without cold currents or complex apparatus.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For a method of providing against injury and accident produced by the Noxious Vapours of Fusees and Explosions in Mining and Tunnelling, by means of improved ventilating apparatus or otherwise.

A PRIZE OF TEN GUINEAS, AND THE SOCIETY'S MEDAL,
For a Mechanical Contrivance for "Coal Whipping," to supersede the necessity of men nearly naked destroying their health and shortening their lives by hoisting coals from vessels on the river.

IV.

## In the SECTION of MANUFACTURES.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For the best application of Glass to the construction of Water-pipes, Tiles, and Drains.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For the invention and application of a Cheaper kind of Glass than any now in use.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For the best Machine for Cutting Wood into given forms.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For the best Imitation of Ivory, in Plaster Composition, for Models and Sculpture.

A PRIZE OF FIVE GUINEAS, WITH THE SOCIETY'S MEDAL,
For the most elegant Design for a Stamped Table-cover in Woollen Materials.

A PRIZE OF TEN GUINEAS, WITH THE SOCIETY'S MEDAL,
For a method of Printing in Distemper by Blocks, so as to "keep register" more perfectly, and produce finer specimens of art in Paper Hangings than by the ordinary methods.

V.

## In the SECTION of COLONIES and TRADE.

THE SOCIETY'S GOLD MEDAL,
For the best applications of Machinery, as a substitute for manual labour, in the various processes of Cultivation and Manufacture of Sugar, Cotton, and Coffee in our West India Colonies and the Mauritius.

THE GOLD ISIS MEDAL,
For the invention or importation of any Material, the produce of our Colonies, as a substitute for Hemp or Flax.

The object to be attained by these Prizes is generally sufficiently obvious, the encouragement of ingenuity and talent by publicity and distinction, the direction of invention to the most useful purposes, and the wider diffusion of taste and knowledge in objects of Arts and improved Manufactures is the object generally of the exertions of the Society.

The Prize for the mixture of ingredients for a wholesome and nutritious bread is the suggestion of a benevolent individual, who has contributed largely to the Prize Fund of the Society. It is peculiarly applicable to the present wants of the people, when the coarser kinds of grain and other food are required to be used for the supply of deficiencies in the usual crops; and it is believed that an article much more nutritious than potatoes, and equally palatable, may be obtained by a mixture of wholesome but cheap materials at a price less than half that of ordinary bread.

The Prizes in the Fine Arts are intended to promote the diffusion of a love for the symmetrical and the beautiful, by supplying in cheap materials, of elegant forms, objects suited to the familiar uses of every-day life. It is required, therefore, of competitors, that the forms chosen be distinguished by simplicity in their beauty, and by facility of execution in cheap materials, so as to be sold at low prices for general use. The Designs rewarded to become the property of the Society. The name of the contributor should be enclosed in a sealed envelope, with a motto or device on the outside. The objects of the remaining Prizes require no explanation.

### NOTICE.

Candidates are requested to observe, that if the means by which any of the proposed objects are effected should be found to occasion an increase of expenditure or labour unsuited to general purposes, the Society will not consider themselves bound to give the offered reward. They expressly reserve the power, in all cases, of giving such part only of any premium as the performance shall be adjudged to deserve, or of withholding the whole. The candidates, however, are assured that the Society will judge liberally of their claims.

All Communications, Drawings, and Models designed for competition must be delivered to the Secretary of the Society of Arts, at the Society's Rooms, John Street, Adelphi, postage and carriage free, on or before the 15th of May, 1846.

### EXTRAORDINARY CONTRIBUTIONS.

The following Extraordinary Contributions have been generously offered to the Council for the promotion of the objects of the Society under the New Rules and Regulations, for furthering the increased usefulness of the Society, for extending the lists of Premiums, for assisting to obtain a Charter, and for the other objects named in the Address of the Council, recently circulated among the Members.

TO THE SPECIAL PRIZE FUND.

| | | |
|---|---|---|
| A. B. | £150 0 0 | |
| C. D. | 50 0 0 | |
| | | £200 0 0 |

GENERAL DONATIONS.

| | | |
|---|---|---|
| Thomas Lewes | £25 0 0 | |
| John Pepys | 10 10 0 | |
| | | £35 10 0 |

LOAN FUND OF £1000.

| | |
|---|---|
| T. Webster | £50 0 0 |
| W. F. Cooke | 50 0 0 |
| F. Whishaw | 50 0 0 |

| | | |
|---|---|---|
| E. Speer | 50 0 0 | |
| J. S. Russell | 50 0 0 | |
| G. T. Kemp | 50 0 0 | |
| Sir I. L. Goldsmid, Bart. | 50 0 0 | |
| R. Stephenson | 50 0 0 | |
| A. A. Croll | 10 10 0 | |
| | | £410 0 0 |

INCREASED SUBSCRIPTIONS.

| | | |
|---|---|---|
| C. Holtzapffel | £6 6 0 | |
| G. Bailey | 6 6 0 | |
| P. Vaughan | 6 6 0 | |
| P. L. M. Foster | 6 6 0 | |
| W. F. Cooke | 6 6 0 | |
| T. Winkworth | 6 6 0 | |
| B. Albano | 6 6 0 | |
| A. Wall | 6 6 0 | |
| W. Everett | 6 6 0 | |
| T. Davison | 6 6 0 | |
| J. Horton | 6 6 0 | |
| W. N. Campbell | 6 6 0 | |
| R. H. Solly | 6 6 0 | |
| J. Reeves | 6 6 0 | |
| L. H. Petit | 6 6 0 | |
| J. Wood | 6 6 0 | |
| A. A. Croll | 6 6 0 | |
| L. Ames | 6 6 0 | |
| | | £113 8 0 |
| | | £758 18 0 |

*The Supplementary List will be published at an early date.*

② THE ARTIZAN.

No. XVII.—New Series.—MAY 1st, 1846.

## Art. I.—NOTES ON LOCOMOTIVES, No. 2.

The cylinders are made of cast iron, ahout three-quarters of an inch thick, and should he of hard metal, so as to have hut little tendency to wear oval from the weight and friction of the piston. The ends of the cylinder are made ahout one inch thick, and both ends are very generally made removable. The valve is invariably of the three ported description. It is made of hrass, and is not pressed upon hy the valve casing, as it is necessary in the ahsence of cylinder escape valves that the steam valve should be capable of leaving the face to enable the steam or air shut within the cylinder to escape when the train is carried on hy its momentum, and also to afford an escape for the water carried over by the steam when priming takes place. The operation of priming upon the cylinders and valves is very injurious, as the grit and sediment then carried over with the steam wears the pistons, cylinders, and valve faces very rapidly, so that if the water he sandy and the engine addicted to priming, the pistons and valves may be worn out and the cylinders require reboring in the course of a few months.

The valve casing is sometimes cast on the cylinder: the face of the cylinder, on which the valve works, is raised a little, so that any foreign matters deposited upon it may he pushed off to the less elevated parts by the valve. The area of the steam ports is in some one-ninth, and in most others one-twelfth or one-thirteenth of the area of the cylinder, and the eduction one-sixth to one-eighth the area of the cylinders—proportions which allow at mean speeds of twenty-five to thirty miles per hour, pressures little different from that of the steam in the steam pipes. The eduction port is one-sixth to one-eighth the area of the cylinders, because it is desirahle to exhaust rapidly, and the volume of the expanded steam hesides is greater than the entering steam; for higher speeds the ports should he larger in proportion. The valve casing is covered with a door, which can he removed to inspect the valves or the cylinder face. Some valve casings have covers upon their front end as well as their top, which admits of the valve and valve hridle heing more readily removed.

A cock is placed at each end of the cylinder to allow the water to he discharged which accumulates there from priming and condensation. The four cocks of the two cylinders are connected, so that hy working a handle the whole are opened or shut at the same time. In Stephenson's engines with variahle expansion, there is hut one cock, which is on the hottom of the valve chest.

The valve lever is usually longer than the eccentric lever, to increase the travel of the valve. The pins of the eccentric lever wear quickly. Stephenson puts a ferule of brass on these pins, which being loose and acting as a roller, facilitates the throwing in and out of gear, and when worn can easily he replaced, so that there need he no material derangement of the motion of the valve from play in this situation. The starting lever travels between two iron segments, and can be fixed at the dead point or for the forward or backward motions. This is done by a small catch or hell crank jointed to the hottom of the handle at the end of the lever, and coming up hy the side of the handle, hut pressed out from it hy a spring. The smaller arm of this bell crank is jointed to a bolt which shoots into notches made in the segments hetween which the lever moves. By pressing the bell crank against the handle of the lever, the holt is withdrawn, and the lever may he shifted to any other point, when the spring heing released, the holt flies into the nearest notch.

We have already discussed the suhject of locomotive pistons in our pages, and can here only add that the pistons which consist of a single ring and tongue piece, or of two single rings set one ahove the other so as to break joint, are preferahle to those which consist of many pieces. In Stephenson's pistons the screws are liahle to work slack and the springs to break. The piston-rods are of steel, the diameter heing from one-seventh to one-eighth of the diameter of the cylinder. They are tapered into the piston, and secured there with a cutter. The top of the piston-rod is secured by a cutter into a socket with jaws, through the holes of which a cross-head passes, which is embraced between the jaws by the small end of the connecting rod, while the ends of the cross-head move in guides. Between the piston-rod clutch and the guide blocks, the feed-pump rod joins the cross-head in some engines. The guides are formed of steel plates attached to the framing, between which work the guide hlocks, fixed on the ends of the cross-head, and which have flanges bearing against the inner edges of the guides. Steel or brass guides are better than iron. Stephenson and Hawthorn attach their guides at one end to a cross-stay, at the other to lugs upon the cylinder cover, and they are made stronger in the middle than at the ends. Stout guide-rods of steel encircled hy stuffing-boxes on the ends of the cross-head, would probably be found superior to any other arrangement. The stuffing-hoxes might contain conical bushes cut spirally, in addition to the packing, and a ring cut spirally might he sprung upon the rod and fixed in advance of the stuffing-box with lateral play, to wipe the rod hefore entering the stuffing-box, to prevent it from heing scratched.

The feed-pumps are made of hrass, hut the plungers are sometimes made of iron, and are generally attached to the piston-rod cross-head, though in Stephenson's engines they are worked hy rods attached to eyes on the eccentric hoops. There is a hall valve between the pump and the tender, and two usually in the pipe leading from the pump to the hoiler, hesides a cock close to the hoiler by which the pump may be shut off from the hoiler in the case of accident to the valves. The hall valves are guided hy four branches which rise vertically and join at top in a hemispherical form. The shocks of the ball against this have in some cases broken it after a week's work, from the top of the cages having heen made flat, and the branches not having had their junction at top properly filleted. These valve guards are attached in different ways to the pipes; when one occurs at the junction of two pieces of pipe it has a flange, which, along with the flanges of the pipes and that of the valve seat, are held together by a union joint. It is sometimes formed with a thread at the under end, and screwed into the pipe. The balls are cast hollow, to lessen the shock as well as to save metal. In some cases, where the feed-pump plunger has heen attached to the cross-head, the piston-rod has heen bent by the strain, and that must in all cases occur if the communication between the pump and hoiler he closed when the engine is started, and there be no escape-valve for the water. Spindle valves have sometimes, heen used instead of hall valves, hut they are more suhject to derangement. Slide valves might easily he applied, and would prohahly be found preferahle to either of the other expedients. It would be a material improvement, we conceive, if the feed-pumps were to he set in the tender, and worked by means of a small engine, such as that contrived hy Messrs. Penn for feeding their tuhular boilers. The present action of the feed-pumps of locomotives is precarious, as if the valves leak in the slightest degree, the steam or boiling water from the hoiler will prevent the pump from drawing. It appears expedient, therefore, that the pumps should be far from the hoiler, and should he set among the feed water, so that they will only have to force. If the pump were arranged in the manner we have now recommended, the boiler could still he fed regularly, though the locomotive was standing still; hut it would he prudent to have one pump still wrought in the usual way hy the engine, in case of derangement of the other, or in case the pump in the tender might freeze.

The feed-pipe of many engines enters the boiler near the bottom, and about the middle of its length. In Stephenson's the water is let in at the smoke-hox end of the hoiler, a little below the water level. By this means the heat is more effectually extracted from the escaping smoke. This arrangement is of questionable applicahility to engines of which the steam-dome and steam-pipe are at the smoke-box end, as in that case the entering cold water would condense the steam.

To ascertain the height of water in the boiler, guage cocks and glass tubes are provided, as in the case of marine boilers. The pipe proceeding from the top of the tuhe in the interior of the hoiler has an upward turn, which is calculated to prevent the water from boiling down through the tube, as it sometimes will do if the boiler he too full. A similar downward turn of the tube at the lower end does not appear calculated to be of service. A small screw plug is placed on each socket opposite the cock to enable a wire to be introduced, to clear the cock, should it become choked. There are generally three gauge cocks attached to the boiler, besides the glass tube, the lowest of which should always run water, and the highest should always blow steam. If the water oscillates inconveniently in the glass tube, the evil may be checked by partially closing the cocks.

The steam whistle is generally placed upon the fire-box dome within reach of the engineer. It consists of a cock, opening by four side holes into an annular chamber, whence the steam escapes through an annular aperture about $\frac{1}{64}$ in. in width, striking in its exit the edge of a bell, fixed by a stem to the cock, whereby the sound is produced. The edge of this bell should be about $\frac{1}{32}$ of an inch thick, and should be exactly over the opening, so that the issuing steam may impinge directly upon it. The metal should be of similar composition to that of clock bells. The whistle is sometimes jointed by running melted lead between its flange and the dome-plate, but it is better to fit the surfaces so truly together as to be steam-tight merely with the assistance of one thickness of fine canvass, coated with red lead or cement; for lead will always be found to decay by contact with high-pressure steam, making continual renovation necessary. This remark equally applies to the other joints connected to the shell of the boiler, such as the guage-tube, blow-off cocks, and feed-pipes.

To save the steam which is formed when the engine is stationary, a pipe is fitted to the boiler which conveys the steam at such times to the tender, where it heats the water and is itself condensed. This method of disposing of the steam is beneficial in descending inclined planes, when more steam is formed than is required for the use of the engine. A cock for emptying the boiler is usually fixed to the bottom of the fire-box; this cock should not be placed at the front end of the fire-box, as the water blown out of the boiler is thrown over the gearing, which is injured by the sand getting into the bearings.

It is very desirable that the length of the connecting-rod should remain invariable, in spite of the wear of the brasses, for there is a danger of the piston striking against the cover of the cylinder if it be shortened, as the clearance is left as small as possible, in order to economise steam. In some engines the strap encircling the crank pin is fixed immovably to the connecting-rod by dovetailed keys, and a screw-bolt passes through the keys, rod, and strap, to prevent the dovetail keys from working out. The brass is tightened by a gib and cutter, which is kept from working loose by three pinching screws and a cross pin or cutter through the point. The effect of this arrangement is to lengthen the rod, but at the cross head end of the rod the elongation is neutralized by making the strap loose, so that in tightening the brass the rod is shortened by an amount equal to its elongation at the crank-pin end. The tightening here is also effected by a gib and cutter, which is kept from working loose by two pinching screws pressing on the side of the cutter. Both journals of the connecting rod are furnished with oil-cups, having a small tube in the centre, with siphon wicks. The connecting-rod is frequently a thick flat bar, with its edges rounded. Stephenson's connecting rod is made at both ends, after the same fashion as the connecting rods of the Black Eagle steamer, represented in the plate of that vessel; but instead of a flat cap a malleable iron strap of round iron passes over both brasses, and is attached to the T end of the connecting rod by means of nuts upon the ends of the bent iron, which is made thickest in the middle, to resist the strain. This plan has the defect of shortening the connecting rod when the brasses are screwed up, and the brasses require to be very strong and heavy. Hawthorn's connecting rod has a strap at each end, tightened by a gib and cutter; but, to obviate the tendency to shorten the rod, the piston-rod end is furnished with a cutter for tightening the brass outwards. The point of the cutter is screwed, and goes through a lug attached to the gib, and is tightened by a nut. It would be preferable to attach the lug to the cutter and the screw to the gib, as the projection of the screw, when the cutter is far in, would not then be so great. In the engines on the Rouen Railway the piston end of the connecting rod has neither strap nor brass, but simply embraces the cross-head, while the crank end is hollowed out to admit brasses, which are tightened by a gib and cutter. The length of the connecting rod varies from four times the length of the crank to seven times. The long connecting rod has the advantage of diminishing the friction upon the slides.

*Eccentrics and Eccentric Rod.*—The eccentrics are made of cast-iron; and when set on the axle between the cranks, they are put on in two pieces held together by bolts; but in straight axle engines they are cast in a piece, and are secured on the shaft by means of a key. The eccentric, when in two pieces, is retained at its proper angle on the shaft by a pinching screw, which is provided with a jam nut to prevent it from working loose. A piece is left out of the eccentric in casting it, to allow of the screw being inserted, and the void is afterwards filled by inserting a dovetailed piece of metal. Stephenson and Hawthorn leave holes in their eccentrics on each side of the central arm, and they apply pinching screws in each of these holes. The screws sometimes slacken and allow the eccentric to shift, unless they are provided with jam nuts. In the Rouen engines with straight axles, the four eccentrics are cast in one piece.

Eccentric straps are best made of wrought iron, as inconveniences arise from the frequent breakage of brass ones. When made of malleable iron, one-half of the strap is forged with the rod, the other half being secured to it by bolts, nuts, and jam-nuts. Pieces of brass are in some cases pinned within the malleable iron hoop, but it appears to be preferable to put brasses within the strap to encircle the eccentric, as in the case of any other bearing. When brass straps are used, the lugs have generally nuts on both sides, so that the length of the eccentric rod may be adjusted; but it is better for the lugs of the hoops to abut against the necks of the screws, and if any adjustment is necessary from the wear of the straps, washers can be interposed. In some engines the adjustment is effected by screwing the valve-rod, and the cross-head through which it passes has a nut on either side of it by which its position upon the valve-rod is determined. The forks of the eccentric rod are steel. The length of the eccentric rod is the distance between the centre of the crank axle and the centre of the valve shaft.

The cranked axle is made of wrought iron, with two cranks forged upon it towards the middle of its length, at a distance from each other answerable to the distance between the cylinders; bosses are made on the axle for the wheels to be keyed upon, and there are bearings for the support of the framing. The axle is usually forged in two pieces, which are then welded together. Sometimes the pieces for the cranks are put on separately, but those so made are liable to give way. In engines with outside cylinders the axles are straight, the crank pins being inserted in the naves of the wheels. The bearings to which the connecting rods are attached are made with large fillets in the corners, so as to strengthen the axle in that part, and to obviate side play in the connecting-rod. In engines which have been used for some time, however, there is a good deal of end play in the bearings of the axles themselves, and this slackness contributes to make the oscillation of the engine more violent. The bearings of locomotive axles should, it appears to us, be made spheroidal, after the fashion we have already recommended for the paddle-shafts of marine engines, whereby end play becomes impossible, and the momentum of the piston should be balanced by the application of a weight to the wheel. If these precautions be observed, locomotives will not oscillate, whether made with outside or inside cylinders, if only resting on four wheels.

The driving wheels are made larger to increase the speed, the bearing wheels also are easier on the road when large; in goods engines the driving wheels are smaller than in passenger engines, and are generally coupled together, as in Bury's engine, represented in one of our plates. Wheels are made in various ways; they are very frequently made with cast-iron naves, and with the spokes and rim of wrought iron. The spokes are forged out of flat bars with T formed heads; these are arranged radially in the founder's mould, whilst the cast-iron centre is poured around them; the ends of the T heads are then welded together to constitute the periphery of the wheel or inner tire, and little wedge-form pieces are inserted where there is any deficiency of iron. In some cases the arms are hollow and of wrought iron, the tire of wrought iron, and the nave of cast iron, and the spokes are turned where they are fitted into the nave, and are secured in their sockets by means of cutters. Hawthorn makes his wheels with cast-iron nave, and wrought iron rim and arms, but instead of welding the arms together, he makes palms on their outer ends, which are attached by rivets to the rim. These rivets, however, unless very carefully formed, are apt to work loose, and we think it would be an improvement if the palms were to be slightly indented into the rim, in cases in which the palms do not meet one another at the ends. When the rim is turned it is ready for the tire, which is now often made of steel. The materials for wheel tires are first swaged separately, and then welded together under the heavy hammer at the steel-works, after which they are bent to the circle, welded, and turned to certain gauges. The tire is now heated to redness in a circular furnace; during the time it is getting hot, the iron wheel, previously turned to the right diameter, is bolted down upon a face-plate or surface; the tire expands with the heat, and when at a cherry-red it is dropped over the wheel, for which it was previously too small, and it is also hastily bolted down to the surface plate; the whole load is quickly immersed by a swing crane into a tank of water about five feet deep, and hauled up and down until nearly cold; the tires are not afterwards tempered. It is not indispensable that the whole tire should be of steel, but a dovetail groove turned out of the tire at the place where it bears most on the rail, and fitted with a band of steel, which may be put in in pieces, answers tolerably well, and is the best way of repairing a worn tire. The steel after being introduced is well hammered, which expands it sideways until it fills the dovetail groove, and it cannot then come out. The tire is attached to the rim by rivets with countersunk heads, and the wheel is then forged on its shaft. The tire is turned somewhat conical, to facilitate the passage of the engine round curves; the diameter of the outer wheel being virtually increased by the centrifugal force, and that of the inner wheel correspondingly diminished, whereby the curve is passed without the resistance which would otherwise arise from the inequality of the spaces passed over by wheels of the same diameter fixed upon the same axle. The rails, moreover, are not set quite upright, but are slightly inclined inwards, in consequence of which the wheels must either be conical or slightly dished, to bear fairly upon them. One benefit of inclining the rails in this way and coning the tires is that the flange of the wheel is less liable to bear against the side of the rail, and with the same view the flanges of all the wheels are made with large fillets in the corners. Wheels have been tried loose upon the axle, but they have less stability, and are not now much used. Much controversial ingenuity has been expended upon the question of the relative merits of the four and six-wheeled engines; one party maintaining that four-wheeled engines are most unsafe, and the other that six-wheeled engines are un-mechanical, and are more likely to occasion accidents. It appears to us that the four-wheeled engines have been eharged with faults which do not really attach to them when properly constructed, for it by no means follows that if the axle of a four-wheel engine breaks, or even altogether comes away, that the engine must fall down or run off the line, inasmuch as if properly coupled to the tender, it has the tender to sustain it. It is obvious enough that such a connection may be made betwen the tender and the engine, that either the hind or fore axle of the engine may be taken away, and yet the engine will not fall down, but will be kept up by the tender; and the arguments against the four-wheeled engines are nothing more than arguments against the want of such a connection. It is no doubt the fact that locomotive engines are now becoming too heavy to be capable of being borne on four wheels at high speeds without injury to the rails; but we fear the objection of damage to the rails applies to the six-wheeled engine with quite as great force, as the engineer has the power in that case of putting nearly all the weight upon *two* wheels, and if the rails be wet or greasy, there is a great temptation to increase the bite by screwing down the driving wheels upon the rail. A greater strain is thus not only thrown npon the rail than can exist in the case of any equally heavy four-wheeled engine, but the engine is made very unsafe, as a pitching motion will be given to it at high speeds, from being poised upon the central driving-wheel; and the engine will also be more subject to oscillation. Stephenson makes his driving-wheels without flanges, to facilitate the passage of the engine round curves, and if six-wheeled engines be made at all, it appears to be expedient to construct them in that manner. But instead of making enormously heavy six-wheeled engines, it appears to us to be preferable to use four-wheeled engines of moderate weight, and to apply a sufficient number of them to a train to enable it to reach the required velocity. To this there is no doubt the objection, that the expense of the propelling power is greater by this arrangement, as a small engine requires a driver and stoker for itself as well as a large engine. But by making the tender double, with one engine before and another engine behind it, a siugle driver and a siugle stoker would suffice for two engines. The starting handles of both engines might be brought to the middle of the tender, so that the engines might be stopped or started simultaneously, and be made to operate in this respect like a single engine. This arrangement appears to us greatly preferable to that of making heavy six-wheeled engines; as the rail will be preserved from the injurious effect of excessive weight, and there will be less loss of power from coutracting the blast-pipe when the fire and flue is increased by the addition of another engine. In all locomotives, there is a material loss of power from the contraction of blast-pipe necessary to maintain the draught; at high speeds one half of the power of the engine is lost by the inadequate area of the steam passage, of which the greatest loss is that arising from the contraction of the blast-pipe. Tenders are now made larger than heretofore, to obviate the necessity of so many coke and water stations; they should have glass windows all round them, to shield the engine driver from the weather, and enable him during the worst winds and rains to keep a steady look out. Tenders can be put on any number of wheels, so that inconvenience is not likely to arise from their size and weight.

The subject of outside and inside framing has already been slightly noticed by us; and the best justification of Messrs Bury's adoption of the inside framing is, that most of the other engineers are beginning to follow their example. In some engines the side frames consist of oak, with iron plates rivetted on each side. The guard-plates are in these cases of equal length, the frames being curved upwards to pass over the driving axle. Hard cast-iron blocks are rivetted between the guard-plates, to serve as guides for the axle bushes. The side frames are connected across at the ends, and cross-stays are introduced beneath the boiler to stiffeu the frames sideways, and prevent the ends of the connecting or eccentric rods from falling down, if they should be broken. The springs are of the ordinary carriage kind, with plates connected at the centre, and allowed to slide on each other at their ends. The upper plate terminates iu two eyes, through each of which passes a pin, which also passes through the jaws of a bridle, connected by a double-threaded screw to another bridle, which is jointed to the framing; the centre of the spring rests on the axle-box. Sometimes the springs are placed between the guard-plates and below the framiug, which rests upon their extremities. Oue species of spring which has gained a considerable introduction consists of a number of flat steel plates, with a piece of metal or other substance interposed between them at the centre, leaving the ends standing apart. It would be preferable, we conceive, to make the plates of a common spring of different curves, so that the leaves, though in contact at the centre, would not be in contact at the ends, but would be brought into contact gradually as the strain comes on; a spring would thus be obtained that was suitable for all loads.

A common mode of connecting the engine and tender is, by means of a rigid bar with an eye at each end, through which the pins are passed. Beteen the engine and tender, however, buffers should always be interposed, as their presence contributes greatly to prevent oscillation and other irregular motions of the engine. A bar is strongly attached to the front of the carriage on each side, and projects perpendicularly downwards to within a short distance of the rail, to clear away stones or other obstructions that might occasion accidents if the eugine ran over them. The axles bear only against the tops of the axle-boxes, which are generally of brass; but a plate extends beneath the bearing to prevent sand from being thrown upon it. The upper part of the box in most engines has a reservoir of oil, which is supplied to the journal by two tubes and siphon wicks. Stephenson uses cast-iron axle boxes with brasses, and grease instead of oil, which is fed by the heat of the bearing melting the grease, and causing it to flow down through a hole in the brass. All the engines with outside bearings have inside bearings also; these are supported by longitudinal bars, which serve also in some cases to support the piston guides; these bearings are sometimes made so as not to touch the shaft unless in the event of its breaking.

The tractive force requisite for drawing carriages over well formed and level common roads is about $\frac{1}{35}$th of the load at low speeds. On railways the tractive force has generally been rated at about $\frac{1}{300}$th of the load, or $7\frac{1}{2}$ lbs. per ton at low speeds, but in well formed railways the tractive force is probably less than this to keep the train moving slowly. The resistance of railway trains, however, increases rapidly with the speed, on account of the resistance of the atmosphere; and the resistance occasioned by the atmosphere may be taken at 15 lbs. per ton, with an ordinary passenger train moving at the rate of 30 miles an hour. The friction of the engine, and the resistance of the rails varies simply as the velocity if the power of the engine remains the same, but the resistance of the atmosphere varies as the square of the velocity, and the power requisite for overcoming that resistance as the cube of the velosity; so that by doubling the speed of a train, by diminishing the load without increasing the power, the friction is doubled; the atmospheric resistance is made four times greater than before, and the power requisite to overcome that resistance eight times greater. This shows the extravagance of high speeds, even if the power were as economically produced at high speeds, which is by no means the case. In moderately light trains upwards of 50 per cent. of the power is expended in overcoming atmospheric resistance in speeds of about 35 miles per hour, and the loss will be greater if the trains be very light, and present a large frontage.

In low pressure condensing engines the evaporation of one cubic foot of water from the boiler may be taken to represent a horse power. In high pressure engines working without expansion the mechanical efficacy of a cubic foot of water raised into steam will be somewhat less on account of the resistance to the motion of the piston, occasioned by the pressure of the atmosphere; but in locomotive engines, where the working pressure is very high, the resistance due to the pressure of the atmosphere becomes relatively nearly as small as the resistance due to the rare vapour within the condenser of a condensing engine; and it will not, therefore, be a material deviation from the trnth, if in locomotive engines, working without priming, we reckon a cubic foot of water evaporated per hour, as equivalent to a horse power. An engine evaporating 200 cubic feet of water per hour, and therefore exerting about 200 horses power draws about 110 tons at 30 miles an hour; but if there were no loss from the resistance of the atmosphere, or of the blast pipe, and no increased friction upon the engine from the increased power requisite for high speeds, the tractive force, if taken at 8 lbs. per ton, would only require to be 70.4 horses power; for $110 \times 8 \times 2640$, the number of feet travelled per minute at 30 miles an hour $\div 33000 = 70.4$ horses power. The friction of a train, however, at 30 miles an hour, including that of an engine of 200 horses power, cannot be taken at much less thau 10 lbs. per ton; for the friction of an engine increases with the power exerted, which determines the pressure upon its moving parts; and the friction of the carriages is also increased at high speeds, iu consequence of the draw bars being attached below the centre of effort of the frontage exposed to the wind, whereby the carriages are pressed down more firmly on the rails. If the traction be taken at 10 lbs. per ton, then the power requisite for the propulsion of a train, setting aside the resistance of the atmosphere, will be about 90 horses power, and the remaining 110 horses power is absorbed in overcoming the resistance of the atmosphere, and of the blast-pipe. If the speed be increased from 30 to 60 miles an hour, about 200 horses power will be required for overcoming the friction of the train, and 880 horses power will be required to overcome the atmospheric resistance, making 1080 horses power, which will be necessary to propel a train of 110 tons, at 60 miles an heur. The evaporation of a locomotive boiler is greatest when the speed is at its maximum, as the blast pipe then produces its greatest effect, and the power of the engine varies nearly as the rate of evaporation, provided the blast-pipe be not unduly contracted. At ordinary railway speeds the power of the boiler is seven or eight times greater than it would be without the blast, though, indeed, such a comparison hardly holds, as without the blast the fire of a locomotive boiler would not draw at all. At a speed of 20 miles an hour a locomotive boiler boils off from 10 lbs. to 14 lbs of water per square foot of heating surface; and the rate of evaporation varies nearly as the $\sqrt[4]{}$ of the speed. The evaporative power of various kinds of boilers has been given in our pages.

The adhesion of the wheels upon the rails is about one-fifth of the weight when the rails are clean, and either perfectly wet or perfectly dry; but when the rails are half wet or greasy the adhesion is not more than one-tenth or one-twelfth of the weight. The weight of locomotive engines varies from 15 to 20 tons: a powerful locomotive engine and tender, such as is suitable for high speeds, will weigh about 25 tons. The consumption of power by the locomotive itself is very great at high speeds, chiefly in consequence of the resistance occasioned by the blast-pipe to the free escape of the steam. Mr. Stephenson considers, that at ordinary railway speeds, a locomotive engine will absorb as much power as 15 loaded carriages, weighing 60 tons, so that in a train of 15 carriages, half the power is consumed by the engine. These determinations, however, are all very indefinite, and experiments are yet wanting to show the power produced and consumed by locomotives, under different circumstances. Locomotive engines costs from £1400 to £1800 each; they run, on an average, about 130 miles a day, at a cost for repairs of about 2½*d.* per mile, and the cost of locomotive power, including repairs, wages, oil and tallow, and coke, may be taken at 6*d.* per mile, on economically managed railways. This does not include a sinking fund for the renewal of engines which may be worn out, and which may be taken at ten per cent. on the original cost of the locomotives. On second class railways the expense of locomotives, and workshops and tools for repairing them, may be set down at £2000 per mile.

Economy of fuel in locomotives is materially promoted by working expansively, but all attempts at economizing fuel in locomotives should begiu with an increase in the area of the fire-grate, so that the power of the engine may not suffer so large a diminution by the creation of the necessary draft. It is a monstrous thing that half of the engine power should be dissipated upon the blast-pipe as in high speeds appears to be the case; and nearly all this power might be saved by enlarging the grate surface and the area of the tubes. There is no saving of heating surface accomplished by the existing construction of locomotive boilers; and all that is gained by the use of the blast is, a saving in the area of fire-grate, which, with a different construction of boiler, might be obtained with a *diminution* in the weight—looking to the effective power of the engine—and with a most important saving of fuel.

Every locomotive engine should be furnished with efficient expansion apparatus of some kind or other, as, setting aside the economy of fuel accomplishable by expansion, it is clear expansion acts beneficially by diminishing the weight of the boiler, which may be made smaller at every increase of the efficiency of the steam. When the draft is strong, a great loss of effect is caused by opening the furnace door, from the refrigeration due to the large volume of air admitted; and it would be a material improvement if the furnace could be fed by some such mechanism as the revolving grate, which we we described in a previous number. The use of sediment collectors in locomotive boilers also appears expedient, as, if judiciously applied, they will effectually prevent the formation of scale upon the tubes, and will also operate as an antidote to priming in many cases. Sediment collectors, applicable to land and marine boilers, have been delieneated and described by us. The form of collector best adapted for a locomotive boiler will depend, in a great measure, upon the peculiar structure of the boiler; but generally, any form will answer which communicates with the water-level and contains water within it in a tranquil state. The **V** shaped cuts, for establishing the communication between the exterior and interior of the vessel, have been found preferable to holes of any other form; for the subsiding particle, so soon as it falls in a slight degree, gets behind the case of the collecting vessel and cannot afterwards escape.

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## Art. II.—PROSPECTS OF IRON SHIP BUILDING.

We have, from time to time, recorded the launching or completion of iron vessels, the production of which has now risen to an important position among the industrial arts; and we have, at various times, offered suggestions with reference to the improvement of the present methods of manufacture. Of the commercial consequences of the innovation one of the evening papers speaks with much intelligence, and to the following effect:—" The change, by the substitution of iron for wood, is inevitable and at hand, for the advantage which it offers is substantiated by incontrovertible proofs; the substitution of material has now been made in sufficiently numerous cases to leave nothing doubtful as to practicability or to results. The iron ships are stronger and lighter, more buoyant, more symmetrical, and more commodious. These of themselves are advances in the art of naval architecture quite adequate, were there no other advantages in prospect, to determine the commercial movement in the new direction. Iron ships will be ordered for the mercantile marine, because they have been shown practically to be cheaper and better than timber ships. Timber ship-building will hold its accustomed ground, until establishments for the construction of iron vessels have slowly grown up to take its place. It will be a work of long time to erect works, and to collect capital, and to train hands for the new labour, which shall equal the constructive power of the united ship-yards of the kingdom. Were it to be otherwise, and the demand for iron ships were suddenly to become urgent, there is no reason why timber ship-builders should not apply their capital, their premises, and their knowledge of naval architecture, to the new construction: there is nothing impracticable or difficult in this conversion of industry; and when a few more models of iron vessels are before them, they will fall very readily into the practice of the new art. However the ancient occupation may be effected by the innovation, there can be no doubt but that iron ship building is about to impart to the country a new industry, aud to open up untried sources of wealth. Looking at the impending change as nothing more than a substitution of one kind of labour for another in the stable business of shipbuilding, it may be thought on a superficial view that we are not going to reap any national benefit by the mere difference of so many men being employed upon iron, whilst an equal number have ceased to be engaged in labour on wood. But this cursory glance does not supply a complete view of the subject. It is the production of the material we are about to employ which will call into activity so large a number of new hands. Our miners of ironstone and coal must be greatly increased. The smelters and converters of iron, from cast to wrought, must be multiplied; and the skilled and unskilled labourers in the large works where iron is fashioned to its specific purposes, will have to be employed in greater numbers. Dependent on these labours of first production will be a vast number of hands employed in the fabrication of the minor parts for putting together and fitting the iron ships, which will be completed altogether under a new order of labour. There are many maritime nations which have every facility for building their own timber ships, which will not have the power for a long time to come, and many of them never, for accomplishing the construction of iron vessels. As the superiority of iron vessels becomes more extensively recognised, we shall be called upon to build for foreigners: it is our proper work, in which for an age we can have no rivals. Coal, iron, and the immense power of large establishments, with practised skill in the conduct and performance of large works, are nowhere else than in Britain to be found in such apposite conjunction for the erection such huge structures as first-class iron ships. We shall have an export trade in a manufacture of the highest economical order, in which the raw material of home production, goes forth clothed with all the labour essential to its final destination. We look to the exportation of iron ships as a new bond of reciprocal benefit between Britain and every great commercial nation; and as an enduring source of alimentation to an immense mass of her industrious population. Iron ship-building, like the cotton manufacture, and other modern industries of large scope, opens up the prospect of certain wealth to those who are the first to occupy the field."

In this view one of the most important elements of success is overlooked or only dimly distinguished—we mean the application of machinery to the production of iron vessels, so as to make their production a manufacture. Iron presents far greater facilities for the introduction of such machinery than wood, yet it has not yet been introduced, and we believe that there are few engineers who do not consider that the present method of constructing iron ships is rude and primitive. If a form of vessel be fixed upon for which a mathematical expression may be found, a machine may be contrived that will bend the ribs to the right curve, and bevel and also bend the plates to the right shape. The plate with thickened edges, introduced by Mr. Fairbairn, appears to afford great facilities in the manufacture of iron ships, though we think the plan imperfect in its present form; and if machinery be introduced that will form the parts accurately, it will be possible to make large pieees of a ship by means of the rivetting machine; and the only hand labour that will then be requisite will be that necessary for fastening these pieces together when put into their places. A rivetting machine, however, will probably be invented that will rivet the parts *in* their places; and if the frames be accurately punched, and accurately set, the application of such a machine does not appear to be difficult. Two strong rollers might be made to travel up on the frame to which the plate to be rivetted had just been applied, and these rollers, if suitably formed and suitably directed, would suffice to accomplish the rivetting operation. To guide the rollers, a carriage with four wheels, of which the rivetting wheel was one, would have to be applied upon the inside of the frame; upon this carriage a small cylinder would be set, connected with a vacuum pipe by means of a flexible tube, aud so soon as the cylinder was put in operation the carriage would mount up on the frame, the wheels of the carriage being armed with projecting spurs to enter the rivet holes, and thus enable it to advance. Such an instrument would not be applicable either at the extreme bow or the extreme stern, on account of the curves there to be met with; and the bow and stern would either have to be plated by hand, or to be formed separately by the ordinary rivetting machine, and to be then put in their places. For strong vessels with thick plates machine rivetting is especially desirable, as, with the force imparted by hand rivetting, it is difficult to make the rivets fill the holes. We believe that iron ships, with auxiliary power and screw propellers must, in time, supersede both ships and steamers for most lines of intercourse; for ships require acceleration, and swift steam vessels will become too expensive when the passenger traffic has been withdrawn from steam vessels by the railways.

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## Art. III.—DUTIES OF STEAM-BOAT ENGINEERS.

The attendants upon engines should prepare themselves for effective action in any casualty that may arise, by considering possible cases of derangement, and deciding in what way they would act should certain accidents occur. The course to be pursued must have reference to particular engines, and no general rules can therefore be given; but every marine engineer should be prepared with the measures to be pursued in the emergencies in which he may be called upon to act, and where every thing may depend upon his energy and decision. If the ship springs a leak, the water may generally be kept under by injecting from the bilge, and every steam-vessel should be provided with cocks for this purpose. These cocks should not communicate with any rose within the condenser, as the water drawn from the bilge is not clean water, and a rose within the condenser would probably soon become choked up. Should there be no injection from the bilge, a great deal of water may be lifted out by partly opening the snifting valves, but should they be of such a construction as not to admit of being opened by a handle, or should they be in an inaccessible position, the cover of the foot valve, or the man-hole door of the condenser may be slackened. If the snifting valve cannot be opened readily, the injection may be shut off, so that the engine will heat, and vitiate the vacuum, and the valve will then open of its own accord during the descent of the air-pump bucket. When raised, it must be prevented from closing again by something being wedged in below it; the steam will then be condensed in the air-pump, and the water drawn through the snifting valve will, in all ordinary leaks, soon leave the ship dry. If fire break out in the vessel, the best plan is to keep all the hatches close, to scuttle the deck, and to direct the hose leading from the deck pump upon the fire. The fire hose must on no account be used for pumping out the boiler, washing the decks, or other such purposes; but must be kept in a locker close beside the deck pump, for the single purpose of quenching fire, and should be examined and oiled once a month. Cotton waste, if oil be spilled upon it, is liable to spontaneous combustion, especially if kept in a hot place, and such combustibles should never be kept in lockers behind or near the boilers, or in any place where there is much light wood work that would readily take fire. The coals often catch fire from spontaneous combustion, but damage rarely arises therefrom: they should be quenched immediately the fire is discovered, by directing upon them a stream of water from the hose. Coal or combustibles of any kind should not be kept under the cabins, as it would be almost impossible to put out a fire among the light joiner-work of the cabins. Some vessels are fitted with a steam-cock for quenching fires, by filling the place with steam; but such a cock, being seldom used, is likely to be neglected and become so much corroded, that it cannot be turned when wanted. If collision occur, and the steamer is cut down by another vessel to the water's edge, it may be necessary to blow off one wing boiler instantly, and fill up the other, so as to give the vessel a list to raise the broken part out of the water. There is no time for hesitation in such cases: the engineer must decide on the instant what he is to do, and must do it at once. In some cases of collision, the funnel is carried away and lost overboard, and such cases are among the most difficult for which a remedy can be sought. If flame come out of the chimney when the funnel is knocked away, so as to incur the risk of setting the ship on fire, the uptake of the boiler must be covered over with an iron plate, or be sufficiently covered to prevent such injury. A temporary chimney must then be made of such materials as are on board the ship. If there are bricks and clay or lime on board, a chimney may be built with them, or if there be sheet-iron plates on board, a square chimney may be constructed of them. In the absence of such materials, the awning stancheons may be set up round the chimney, and chain rove in through among them in the manner of wicker-work, so as to make an iron wicker chimney, which may then be plastered outside with wet ashes, mixed with clay, flour, or any other material that will give the ashes cohesion. War steamers should carry short spare funnels, which may easily be set up should the original funnel be shot away; and if a jet of steam be let into the chimney, a very short and small funnel will suffice for the purpose of draught.

If the crank pin breaks, the other engine must be worked with the one wheel. It will sometimes happen, when there is much lead upon the slide valve, that the single engine on being started cannot be got to turn the centre if there be a strong opposing wind and sea—the piston going up to near the end of the stroke and then coming down again, without the crank being able to turn the centre. In such cases it will be necessary to turn the vessel's head sufficiently from the wind to enable some sail to be set, and if once there is weigh got upon the vessel, the engine will begin to work properly, and will continue to do so, though the vessel be put head to wind as before. If the eccentric catches or hoops break or come off, and the damage cannot readily be repaired, the valve may be worked by attaching the end of the starting handle to any convenient part of the other engine, or to some part in connection with the connecting rod of the same engine. In side lever engines, with the starting bar hanging from the top of the diagonal stay, as is a very common arrangement, the valve might be wrought by leading a rope from the side lever of the other engine through blocks, so as to give a horizontal pull to the hanging starting bar, and the bar could be brought back by a weight. Another plan would be to lash a piece of wood to the cross tail butt of the damaged engine, so as to obtain a sufficient throw for working the valve, and then to lead a piece of wood or iron from a suitable point in the piece of wood attached to the cross tail to the starting handle, whereby the valve will receive its proper motion. If the shafts or cranks crack, the engine may nevertheless be worked with moderate pressure to bring the vessel into port; but if the crack be very bad, it will be expedient to fit strong blocks of wood under the ends of the side levers, or other suitable part, to prevent the cylinder bottom or cover from being knocked out, should the damaged part give way. The same remark is applicable where flaws are discovered in any of the main parts of the engine, whether they be malleable or cast-iron, but they must be carefully watched, so that the engines may be stopped if the crack is extending farther. Should fracture occur, the first thing obviously to be done is to throw the engines out of gear, and should there be much weigh on the vessel, the steam should at once be thrown on the reverse side of the piston, so as to counteract it.

Such, then, are the most important of the points which suggest themselves in connection with the management of marine engines when they are at work; we have next a few remarks to offer upon the general management of the engine-room, and upon the secret of economy in the working of steam vessels. In dealing with the firemen and coal trimmers, there must be as many *standing orders* as possible, so that the engineer may be saved a perpetual expenditure of thought on mere matters of routine, whereby his attention may be given to more important objects. The coal trimmers have usually the care of the lamps, the whole of which should be collected, cleaned, and trimmed every morning, and each then put in its proper place. For every thing in the engine room there should be a place, and for its being there, and being clean and fit for use, some person or other should be responsible, It appears to be expedient to give to the best fireman a few shillings a week more than the rest, and to make him responsible for all the spanners, the blocks for raising cylinder and air pump covers, and the screw for the paddle-wheels; and all these articles should be ranged, like the muskets of an armoury, upon the engine room bulk head. The spare gear should be ranged in the same situation, and should either be painted or be kept bright. The oil cans, lamps, and tallow kettles, may be put under the charge of the head coal trimmer; they should all be of brass of the same colour, and should be kept bright and clean. Of the oil tank, tallow locker, and waste chest, the engineer himself should keep the key, and should give out every morning the quantity allowed for the day's consumption. Bolts, copper drifts, and other light miscellaneous articles, the engineer should keep locked up in his store closet, where also he should keep his hammers and chisels, saws, drills, taps and dies, files, smith's tongs, and other similar implements. The paddle bolts and plates are in the charge of the carpenter, but the engineer should ascertain that the carpenter is always provided with a sufficient supply. Every steamer intended for the performance of other than short voyages, should be provided with a smith's forge and anvil, and with a small turning lathe. The smith's forge should be of a compact form, with the bellows situated beneath the hearth, and it should be set in a recess in the engine room, where it is always in sight; if stowed away in a dark place, the leather of the bellows will become mouldy and rotten. The engineer's store closet should be made with a glass door, so that any one visiting the engine room may see that the various articles in it are well taken care of, and that each is in its right place. The whole of the bolts about the engine of the same diameter should be made with the same pitch of screw, and the taps and dies supplied to the engineer should correspond therewith. Where there is a line of several vessels, it is most important that the whole of the engines should be the same, so that any part of one engine may fit all the others. The boilers should also be of the same size, though they need not be of the same internal structure; and so soon as a boiler becomes much worn, it should be taken out and replaced by another, which is kept in readiness—the worn boiler being then thoroughly repaired ashore, and made fit for putting into another vessel. This plan is much more economical than that of executing heavy boiler repairs on board the vessel; and the beams above the boiler, the coal boxes, and all the boiler attachments, should be so contrived, that the boiler may be removed with facility. The firing tools and instruments for removing the deposit through the mudhole doors, are usually laid on hooks in the engine room, fixed against the side of the ship, and beneath these hooks the ash buckets and buckets for quenching the fires may be ranged. These buckets should be of strong sheet iron, with rims round top and bottom. The lamps used in the coal boxes and for cleaning the boilers, may be made of a short piece of malleable iron pipe staved up round at the one end, and with a bottom brazed in at the other; and short side pipes for the wicks may then be brazed on, which pipes should lead to near the bottom of the lamp: through a small hole in the top, another pipe should descend to near the bottom of the lamp, which may be furnished at the top with a projecting neck, on which a swivelling handle may be fixed. The oil is poured through the central pipe, and cannot be spilled though the lamp is turned upside down, nor can such a lamp be easily broken. The engineer will always require to carry glass gauge tubes with him, and the glass tube sockets should be so made that a tube may be put in at sea. The cocks connecting the glass tubes with the boiler, should be so made as to admit of the tubes being blown through with steam to clear them, as in muddy water they will become so much soiled, that it will be difficult to see the water. The whole of the articles of engine room furniture should be entered in a catalogue, and the engineer should be held responsible for their safe custody and preservation. The various engine room stores required, such as white and red lead, paint and paint oil, pasteboard, rope yarn, emery paper, Bath brick, brooms, shovels, and other articles, should all have their appropriate places in the store closet, and the engineer should, for his own satisfaction, keep an account of the consumption of them.

Steam vessels, to work economically, should have large engine power with moderate boiler power; they should make as much use of sails as possible, and in fair winds or fine weather should work very expansively. In the case of adverse winds or tides, on the contrary, they should exert their full power, as it is only the excess of power possessed by a vessel over that requisite to stem an adverse wind or current, that is available for her propulsion; and the greater the power, the less will be the proportionate loss from her subjection to such influences. In fair winds, the engineer should use such a measure of expansion as will maintain the speed at about ten knots per hour; speeds materially higher than this are only got at a great proportionate expenditure of power; and in the generality of cases, the object, when this speed is obtained, should be not to increase the speed, but to save fuel. Sails are far too little used in steam vessels; many captains never set them at all; but every sail unset when the wind is fair involves an expenditure of fuel which might otherwise be saved. The resistance opposed to vessels moving through water increases as the square of the velocity, and the power requisite to overcome that resistance as the cube of the velocity; so that to double the speed takes eight times the power. The centre of pressure of the paddle boards should not move much more rapidly than the vessel moves through the water, else there will be a great loss of power from slip, the power being wasted in forcing the water back from the wheel instead of being expended in forcing the vessel forward. The proportion of float-board, therefore, or the dip of the wheel, is an element of economy in the working of steam vessels, and must have reference to the power of the engine and the resistance experienced by the vessel. Four or five floats are usually immersed in the larger class of sea-going vessels; and with such a dip the engines are not subject to injurious fluctuations of speed from the roughness of the sea. The power exerted by an engine is of course greater when working fast than when working slow; but if the increased speed be obtained by an inadequate float surface, the increased power will be more than thrown away in churning the water, and the result will be an increased consumption of fuel with a diminished speed, or, in the most favourable case, with a speed not increased in anything near the ratio of the increased consumption of fuel.

The most beneficial amount of float surface having been determined, as may easily be done by trying the effect of different degrees of expansion if the float surface be too small, and by lightening the vessel, or hoisting sail, if it be too large, the floats should be firmly secured in their places; but it may be taken as a general rule, that the *horizontal* speed of the entering float must be as great as that of the ship, else the entering float will carry a sea before it, as is done by the bow, and will impede instead of aiding the vessel's progress. The steam pipes should be clothed with felt and covered with wood, and the cylinders and boilers should also be effectually clothed, as has been already stated, so as to prevent the dispersion of heat, and to keep the engine room cool. Care must be taken that the pistons and valves do not leak steam, which would greatly increase the consumption of fuel; and their tightness should be occasionally tested by lifting the covers and letting the steam in below the valves and pistons. The engineer should assure himself, when getting coals on board, that he really receives the quantity professed to be given, and one of the engineers should see the whole quantity weighed; he should also compute the capacity of the coal-boxes, as an additional check, and if they hold too much he may be tolerably sure that he has not received his quantity. The density of coal varies somewhat; the bushel of Welsh coal being 94lbs., while the bushel of Staffordshire coal is only 84 lbs. But it is an easy thing for the engineer to weigh a vessel of the coal of any given capacity in cubic feet, from whence the weight of any other number of cubic feet can readily be determined. On the average, a ton of coal occupies a measured ton of stowage. If the coals occupy more than the computed space, the inference is that they are badly stowed. Long furnaces are generally more extravagant in coal than short furnaces; and many cases might be mentioned where shortening the furnaces has been attended with an increased consumption of steam, as well as with a saving of fuel. A great economy, both in fuel and in wages, would be accomplished if marine boilers were to be fired by machinery instead of by hand, and an important benefit to steam navigation would be achieved by the practical introduction of this improvement.

The expedients of economy here enumerated will certainly be productive of important results if effectually carried into effect, yet we should not be disposed to trust implicitly to these or any other recipes, but would seek to enlist the interests of the engineer and captain in the success of any projected scheme of economy. We therefore recommend to more general adoption the system of giving the captain and engineer a share in the savings of coal that they accomplish: and we should further give the engineer a share of any savings in the consumption of oil, tallow, or other stores, that he can effect. We include the captain in the award of the savings of fuel, because by his exertions the saving may be materially increased, or the engineer's exertions may be in a great measure defeated if the captain neglects to hoist sail, or pursues zig-zag courses. It would be still preferable, however, for steam companies, if they could contract for the maintenance of the propelling power with some responsible party, who would make the development of all measures of increased efficiency and economy a business, and would thus be more likely to work them effectually out; and who could make the necessary bargains with captains and engineers. We believe that companies would derive a similar benefit from this arrangement to that experienced by the government, when it let out by contract the conveyance of the mails. The expense of every steam vessel running would thus be a determinate thing, and the company would be able to give its exclusive attention to what is after all its legitimate function,—that of increasing its profits, and improving its commercial position. The appetite for power and patronage prevailing among the managers of companies may defeat, in some cases, such an innovation; but we believe that it will eventually become a general arrangement, and one that will be found beneficial to both of the contracting parties. In the case of railway locomotion it is already extensively practised, and is found to be attended with satisfactory results.

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## Art. IV.—TIDAL HARBOURS.

The Tidal Harbour Commission are pursuing their investigations with industry and success, and the most beneficial result may reasonably be expected from their labours. The abuses which have crept into the administration of many of our harbour trusts are being exposed with an unsparing hand, and it will be impossible for those abuses to survive in the atmosphere of light with which they are now surrounded. The commissioners have just published their second report which we cannot find space to give *in extenso*, but we shall here introduce some extracts from it:—

" A more extended inquiry has fully confirmed the views which the limited examination of last year led us to submit to your Majesty. Not only is there a general want of controul over the management and revenue of the ports, but there is not a single exception among the numerous cases which have come before us, in which such a controul might not have been the means of saving unnecessary outlay; of preventing encroachments that can now be scarcely remedied; or of stopping works that must now be removed in order to secure the objects to which the attention of the commission is directed. The necessity of such supervision has also become more apparent since the publication of the returns to the orders of the House of Commons of August last, from which we learn that the income of the various ports of the United Kingdom exceeds the sum of £800,000 a year considerably—the whole levied by charters and acts of Parliament, or otherwise, from dues on shipping, and on goods borne by shipping, but over the expenditure of which Parliament has not at present the slightest controul. That much of this money has been, and is misapplied will excite no surprise, when we find that several harbours are governed by numerous self-elected, irresponsible commissioners, (in some places exceeding even one hundred in number), often conducting their proceedings in private, auditing their own accounts, publishing no statement of income or expenditure, and laying out large sums of money without the advice of an engineer; and that these commissioners are frequently landed proprietors, sometimes non-residents, occasionally a ship-owner, but rarely a sailor among them. Such however, is the constitution of many of the harbour-boards of this country, acting under authority conferred by Parliament.

" Since the date of our first report, we have, in compliance with that clause of Her Majesty's Commission, which directs us to visit and personally inspect all the harbours and shores of the United Kingdom, examined the chief ports on the east coast of England, from the river Thames to the Tyne, thus including Yarmouth, Hull, and the principal coal ports of Durham and Northumberland, which owing to the extraordinary increase in steam navigation, are daily rising to greater importance. On the west coast we have personally inspected the rivers Lune, Wyre, Ribble, and Dee, and the ports of the Isle of Man, which although of small extent as harbours, become of consequence from their position in the centre of the Irish Channel, and as the head quarters of an extensive and increasing fishing trade. In Ireland we have been enabled to visit most of the ports and fishing-piers around the coast, and have been strongly impressed by a sense of the great value of its natural harbours, their depth and capacity, and the extent and capability for improvement of its fisheries, which, even in their present state, and with the fishery-piers often in ruins from neglect, afford employment to 19,880 vessels and boats, and 93,000 hardy fishermen. But these natural advantages are very far from having been turned to the best account.

" The harbour of Dublin and the river Liffey offer an instructive example of the correctness of this statement. Within the last thirty years many improvements have taken place. The depth of water over the bar and up to the city quays has been increased several feet, by dredging, and by the bold measure of running out the great north wall. The traffic and consequent revenue of the port have more than doubled, and the latter has risen to £34,000 a year. Yet the evidence shows that the foundation of the quays is generally so imperfect that they will not, in their present state, admit of the river being further deepened: that the south quay, the resort of three-fourths of the shipping of the port, is encumbered at its foot by heaps of mud; that the entrance into the grand canal dock is all but blocked up by sand banks; that there is a great want of graving docks; that there is but one public crane; that the port charges are very high; and that the ballast, of which, by Act of Parliament, the ballast office has a monopoly, and for which it charges about double the market price, is in many cases bad.

"The Isle of Man occupies an important position in the Irish Channel, directly in the track of communication between Liverpool, Glasgow, and Belfast, and of the coal trade from Whitehaven and Maryport to the whole of the east coast of Ireland. It has been aptly termed the 'Beacon of the Irish Sea,' and as such everything that care and skill can suggest, as to lights, beacons, and improvement of its harbours, would be well bestowed, and tend to prevent the recurrence of the numerous wrecks that have taken place around its shores. Yet such is far from being now the case; on the contrary (with the exception of the coast lights maintained by the Board in Scotland), marked neglect prevails throughout; and here the evils of irresponsible, self-elected authority are but too manifest, the Commissioners meeting only once a year to go through the form of auditing their own accounts, keeping no regular minutes of their proceedings, and practically leaving the whole power and authority in the hands of a single person. On the north-west coast of England, the river Lune and the port of Lancaster are capable of much improvement. The river Ribble and port of Preston offer a proof also of the value of skilful engineering as applied to navigable rivers."

The improvements of the river Ribble were executed under the direction of Mr. Stevenson of Edinburgh, whose novel form of coffer dam for the excavation of rock in rivers we described in our first volume. The Ballast Board of Dublin is a jobbing confederation who have expended enormous sums of money with but little effect. A ship canal between Dublin and Kingstown harbour was proposed some years ago by Messrs. Bourne, and Mr. Cubitt, who surveyed the ground, pronounced the scheme to be feasible and probably beneficial, but the project miscarried from some compromise, as it is supposed, on the part of Mr. O'Connell. The Commissioners would do well to reconsider this scheme, which Mr. Nimmo and other engineers have also recommended, and if it appears to be a wise one it may be hoped that it will be carried into effect by their influence, instead of having to rely upon the precarious aid of patriots, who may barter it away for some electioneering advantage.

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## Art. V.—STRENGTH OF BOILERS.

The breaking strain of good iron is about 60,000 lbs. on the square inch, but the best malleable iron will not bear a greater load than about 13,000lbs. on the square inch, without permanent derangement of structure. Tredgold gives a rule for determining the strength of cylinders, cylindrical boilers, and other such vessels, which gives proportions not far from those which are advisable. It is this:—Multiply 2·54 times the internal diameter of the cylinder by the greatest force of steam on a circular inch; divide by the tensile force the metal will bear without permanent derangement of structure; the result is the thickness in inches. In practice, the iron of boilers has sometimes to sustain a greater strain than what is indicated in this rule. The utmost strain to which iron can be safely subjected in machinery, is 4000lbs. on the square inch, and this strain is approached in locomotive engines. A cylinder 12 in. diameter, with a piston-rod $1\frac{3}{4}$in. diameter, and with steam of 80lbs. on the square inch, bears a tensile strain of 3766lbs. on the square inch. Upon the iron of the boiler the strain is still greater, being about 5000 lbs. on the square inch. If the plate be 5-16 thick, it will require 3·2 in. in length of the boiler to make a square inch of sectional area, and if the diameter be 39 in., the separating force will be 39 + 3·2 + 80= 9984lbs. But this strain is borne by a square inch of sectional area on each side of the boiler, wherefore the strain on a single square inch of sectional area is half of this, or nearly 5000lbs. This takes no account of the support derived from the boiler ends, but in long boilers the support derived from the ends is but small, and is not equivalent to the weakness caused by the rivet holes. A strain at all approaching that upon locomotive boilers would be most unsafe in the case of marine boilers, on account of the corrosion to which they are subject. All boilers should be proved with water when new to three or four times the pressure they are intended to carry, and they should be proved occasionally by the hand-pump, when in use, to detect any weaknesses that corrosion may have created.

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## Art. VI.—MANAGEMENT OF LOCOMOTIVES.

The most important part of the engine driver's duty is the observance of signals, respecting which no general rules can be given, as the systems of signals vary upon different railways; but a strict attention to the signals fixed upon, and a constant watchfulness to see that the rail is free from obstruction, constitute the most important part of the duty the engine-driver has to perform. He should constantly be upon the foot-board of the engine, so that the regulator, the whistle, or the reversing handle, may be used instantly if necessary: at the same time he must see that the level of the water in the boiler is duly maintained, and that the steam is kept at a uniform pressure. In feeding the boilers with water, and the furnaces with fuel, a good deal of care and some tact are necessary, as irregularity in the production of steam will often occasion priming, even though the water be maintained at a uniform level, and an excess of water will of itself occasion priming, while a deficiency is a source of obvious danger. The engine is generally furnished with three guage cocks, and water should always come out of the second guage cock, and steam out of the top one when the engine is running; but when the engine is at rest the water in the boiler is rather lower than when it is in motion, so that when the engine is at rest the water will be high enough if it just reaches to the middle guage cock. The boiler should be well filled with water on approaching a station, as there is then steam to spare, and additional water cannot be conveniently supplied when the engine is stationary. The furnace should be fed with small quantities of fuel at a time, and the feed should be turned off just before a fresh supply of fuel is introduced. The regulator may at the same time be partially closed, and if the blast-pipe be a variable one it will be expedient to open it widely while the fuel is being introduced, to check the rush of air in through the furnace door, and then to contract it very much so soon as the furnace door is closed, in order to recover the fire sooner. The proper thickness of coke upon the grate depends upon the intensity of the draft, but in heavily loaded engines it is usually kept up to the bottom of the fire door. Care, however, must be taken that the coke does not reach up to the bottom row of tubes so as to choke them up. The fuel is usually disposed on the grate like a vault, and if the fire box be a square one, it is heaped high in the corners the better to maintain the combustion. In starting from a station, and also in ascending inclined planes, the feed water is generally shut off, and therefore before stopping or ascending inclined planes the boiler should be well filled up with water. In descending inclined planes an extra supply of water may be introduced into the boiler, and the fire may be fed, as there is at such times a superfluity of steam. In descending inclined planes the regulator must be partly closed, and it should be entirely closed if the plane be very steep. The same precaution should be observed in the case of sharp curves or rough places on the line, and in passing over points and crossings. To ascertain whether the pumps are acting well the pet-cock must be turned, and if any of the valves stick they will sometimes be induced to act again by working with the pet-cock open, or alternately open and shut. Should the defect arise from a leakage of steam into the pump, which prevents the pump from drawing, opening the pet-cock remedies the evil by permitting the steam to escape. Should priming occur from the water in the boiler being dirty, a portion of it may be blown out, and should there be much boiling down through the glass guage tube the top cock may be partially closed. The water should be wholly blown out of locomotive boilers three times a week, and at those times two mudholes at opposite corners of the firebox should be opened, and the boiler be washed internally by means of a hose.

On approaching a station the regulator should be gradually closed, and it should be completely shut at about half a mile from the station if the train be a heavy one, and the train may then be brought to rest by means of the breaks. Too much reliance, however, must not be put upon the breaks, as they sometimes give way, and in frosty weather are nearly inoperative: in cases of urgency the steam may be throw upon the reverse side of the piston, but it is desirable to obviate this necessity as far as possible. At terminal stations the steam should be shut off earlier than at roadside stations, as a collision will take place at terminal stations if the train overshoots the place at which it ought to stop. There should always be a good supply of water when the engine stops, but the fire may be suffered gradually to burn low towards the conclusion of the journey. So soon as the engine stops it should be wiped down and be then carefully examined. The brasses should be tried to see whether they are slack, or have been heating; and it should be ascertained occasionally whether the wheels are square on their axles, by the application of a gauge, and whether the axles have end play, which should be prevented. The stuffing boxes must be tightened, the valve gear examined, and the eccentrics be occasionally looked at, to see that they have not shifted on the axle, though this defect will generally be intimated by the irregular beating of the engine; the tubes should also be examined and cleaned out, and the ashes emptied out of the smoke box through the small ash door. If the engine be a six-wheeled one, it will be liable to pitch and oscillate if too much weight be thrown on the driving wheels; and where such faults are found to exist, the weight upon the driving wheels should be diminished. The practice of blowing off the boiler by the steam, as is always done in marine boilers, should not be permitted as a general rule in locomotive boilers when the tubes are of brass and the fire-box of copper; but when the tubes and fire-boxes are of iron it may safely be done. Before starting on a journey the engine-man should take a summary glance beneath the engine, but ought first to assure himself that no other engine is coming up at the time. The regulator when the engine is standing should be closed and locked, the eccentric rods be fixed out of gear, and the tender break screwed down. The cocks of the oil vessels should at the same time be shut, but should all be opened a short time before the train starts.

Most of the accidents attended with loss of life upon railways have been occasioned by persons jumping on or off the train whilst in motion, and many cases might be cited of engine drivers and stokers having been killed by falling off the engine—in some cases from the coupling of the engine and tender suddenly giving way. The most frequent causes of collision are fogs, and the absence of a uniformity of time at the different stations along the line in consequence of their difference of longitude. Collisions have sometimes occurred from carriages having been blown from a siding upon the rails by a high wind, and the slippery state of the rails, or the fracture of a break, has in some cases caused collision at a terminal station. Collision has also taken place from one engine having overtaken another, in consequence of the imperfect condition of the first engine from a leaky tube or otherwise. When a tube bursts, a wooden or iron plug must be driven into each end of it, and if the water or steam be rushing out so fiercely that the exact position of the imperfection cannot be discovered, it will be advisable to diminish the pressure by increasing the supply of feed water. Should the leak be so great that the level of the water in the boiler cannot be maintained, it will be expedient to drop the bars and quench the fire, so as to preserve the tubes and fire-box from injury. Should the wooden casing of the boiler catch fire, it may be extinguished by throwing a few buckets of water upon it, or if the engine is at a station, it may be brought under the water crane. Should the piston rod or connecting rod break, or the cutters fall out, or be clipped off as sometimes happens to the piston cutter when the engine is suddenly reversed upon a heavy train, the parts should be disconnected, if the connection cannot be restored so as to enable one engine to work, and of course the valve of the faulty engine must be kept closed. If one engine has not power enough to enable the train to proceed with the blast-pipe full open, the engine may perhaps be able to take on a part of the carriages, or it may run on by itself to fetch assistance. The same course must be pursued if any of the valve gearing becomes deranged, and cannot be rectified upon the spot.

Before leaving a station, the engine driver should always assure himself that he has the requisite supply of coke and water, and should not trust to the attention of the stoker respecting such matters. Besides the firing tools and rakes for clearing the tubes, he should have with him in the tender a small oil tank and a small tallow chest, a box of waste, some rope yarn, gasket, canvass, and white lead; two small oil cans, an oil syringe, spanners, and one shifting key, a chipping hammer, chipping chissels, and a file; a coal hammer, some wooden and iron plugs, and an iron plug-holder, a sheet iron bucket, a screw jack, two crow-bars, a chain, and some wooden wedges. The whole of these articles should be arranged in the tender in suitable places, so that the engine driver may know where to put his hand upon any article, and can see at a glance whether any of them is missing. A few spare bolts of different sizes should also be carried. To economise fuel in locomotives a variable expansion gear is very desirable, which may be adjusted to the load, and the blast pipe must be worked with the least possible contraction. At stations the damper should be closed to prevent the dissipation of the heat. Anthracite has been tried for locomotives instead of coke, but it crumbles down into a powder and forms a compact mass upon the bars which prevents the admission of an adequate supply of air to the furnace. If the area of grate be enlarged however it appears probable that anthracite may be used if mixed with coke. Upon some railways premiums are given to the engine drivers for economizing fuel. The practice appears to us to be commendable enough, but it should be coupled with the publication of the consumption of the locomotives of different makers as no amount of care on the part of the engine driver will suffice to correct the vices of an imperfect machine.

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## Art. VII.—EXPERIMENTS ON GUNPOWDER.

A report has been published containing the results of numerous experiments on the force of gunpowder, made at Washington arsenal, by Captain Mordecai, of the American Ordnance department. Captain Mordecai concludes that the only mode of proving the strength of gunpowder, is by testing it with service charges in the arms for which it is designed. In the twenty-four pounder, new cannon powder with a charge of one fourth the weight of the ball, should give an initial velocity of not less than 1600 ft. to a ball of medium size and windage. The initial velocity of the musket ball of 0·05 in windage, with a charge of 120 grains, should be not less than 1500 ft. with new musket powder, 1600 ft. with new rifle powder, and 1800 ft. with fine sporting powder. The American proportions for their best gunpowder are 76, 14, 10, and the English 75, 15, 10, and these appear to give good results. The best mode of manufacture, is, with the cylinder mills, in which the materials pass under heavy rollers; this method which is said to be only one, by which good sporting powder can be made, has been used in England for the last fifty years, but in France stamping or pounding is still adhered to. The "gravimetric density" should not be more than 920, or less than 850. The ordinary charge for cannon should be $\frac{1}{4}$ the weight of the ball, and for no purpose is more than $\frac{1}{3}$ required. Captain Mordecai proposes that the charges of rifle powder should be 110 grains for the percussion musket, 75 grains for the percussion rifle, and 30 grains for the percussion pistol. He also proposes that musket and rifle balls should be made by compression instead of casting.

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## Art. VIII.—NAPTHALIZED COAL GAS.

Mr. Lowe's patent for increasing the illuminating power of gas, by charging it with the vapour of naptha, has been authorised by the judicial committee of the privy council to be extended for seven years. The method prescribed by the patent for impregnating the gas with naptha, consists in the introduction of naptha into the gas meter instead of water; but the fire insurance companies objected to this innovation, and Mr. Lowe therefore adopted the plan of causing the gas to pass through a vessel in which sponges charged with naptha had been inserted. But although the light thus produced was admitted to be superior to any other, the inventor had been unable to bring it into general use, and hitherto had received no return for it whatever. In the evidence given on the occasion, Sir James Clark said, he had used the napthalized gas in his house for some years. It gives a clearer and more powerful light than coal gas, with less heat, and produces fewer deleterious substances; it also exhibits colours more clearly. Mr. B. Hawes director of the Chartered Gas Company, said that he had used the napthalized gas in his house, and thought it a great improvement. It gives a stronger and clearer light at less cost. He endeavoured to get the company to introduce it into general use; but was met by the argument that the consumption of gas would fall off. His answer was, "Give the public a good article cheap, and consumption will increase, and make up for the diminution of price." So far as he knew, the inventor had not received a shilling for the use of the light, yet he had had great difficulty in introducing it. Dr. Reid said that he considered the napthalized gas an important invention; it produced from thirty to fifty per cent. more light than common gas, with less heat. Mr. A. Smee, F.R.S., said that he had used the napthalized gas. With the same quantity of light there is less heat, with a saving of twenty per cent. in gas; and it is more favourable to the human countenance, and to the distinguishing of colours. The Chartered Gas Company has we conceive, pursued a very narrow sighted policy in refusing to introduce this invention; as if it be really beneficial it would bring to them so large a proportion of the public patronage as would materially add to their profits and success.

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## Art. IX.—ERECTION OF SIDE-LEVER ENGINES.

Level the bed-plate lengthways and across, and strike a line up the centre as near as possible in the middle, which indent with a chisel in various places, so that it may at any time be easily found again. Strike another line at right angles with this, either at the cylinder or crank-centre, by raising a perpendicular in the usual manner. Lay the other sole-plate alongside at the right distance, and strike a line at the cylinder or crank centre of it also —shifting either sole-plate a little endways, until these two transverse lines come into the same line, which may be ascertained by applying a straight edge across the two sole-plates. Strike the rest of the centres across, and drive a pin into each corner of each sole-plate, which file down level, so as to serve for points of reference at any future stage. Next try the cylinder on; plumb it on the inside roughly, and see how it is for height, in order to ascertain whether much will be required to be chipped off the bottom, or whether more requires to be chipped off the one side than the other. Chip the cylinder bottom fair; set it in its place, plumb the cylinder very carefully with a straight edge and silk thread, and scribe it so as to bring the cylinder mouth to the right height; then chip the sole-plate to suit that height. The cylinder must then be tried on again, and the parts filed wherever they bear hard, until the whole surface is well fitted. Next chip the place for the framing; set up the framing, and scribe the horizontal part of jaw with the scriber used for bottom of cylinder—the upright part being set to suit the shaft centres, and the angular flange of cylinder where the stay is attached having been previously chipped plumb and level. The stake-wedges with which the framing is set up preparatory to the operation of scribing, must be so set as to support equally the superincumbent weight, else the framing will spring from resting unequally, and it will be altogether impossible to fit it well. In some of the modern direct-action engines, many of the directions here given will be found needless; for the cylinder flange and cylinder bottom are both faced in the boring mill, and the framing consists of malleable iron rods, which involve but little difficulty in fitting them together; but whoever can fit together a side lever engine with cast-iron framing, will find little difficulty in fitting together any other kind.

In fixing the positions of the centres, it appears to be the most convenient way to begin with the main centre. The height of the centre of the cross-head at half-stroke above the plane of the main centre, is fixed by the drawing of the engine, which gives the distance from the centre of cross-head centre at half-stroke, to the flange of the cylinder; and from thence it is easy to find the perpendicular distance from the cylinder-flange to the plane of the main centre, merely by putting a straight edge along level, from the position of the main centre to the cylinder, and measuring from the cylinder-flange down to it, raising or lowering the straight edge until it rests at the proper measurement. The main centre is in that plane, and the fore and aft position is to be found by plumbing up from the centre line on the sole-plate. To find the paddle-shaft centre, plumb up from the centre line marked on the edge of the sole-plate, and on this line lay off from the plane of the main centre the length of the connecting rod, if that length be already fixed; or otherwise the height fixed in the drawing of the paddle-shaft above the main centre. To fix the centre for the parallel-motion shaft, when the parallel-bars are connected with the cross-head; lay off on the plane of main centre the length of the parallel bar from the centre of the cylinder, deduct the length of the radius crank, and plumb up for the central line of motion shaft; lay off on this line, measuring from the plane of main centre the length of the side rod: this gives the centre of parallel motion-shaft when the radius-bars join the cross-head, as is the preferable practice where parallel motions are used. The length of the connecting-rod is the distance from the centre of the beam when level, or the plane of the main-centre to the centre of the paddle-shaft. The length of the side-rods is the distance from the centre-line of the beam when level, to the centre of the cross-head when the piston is at half-stroke. The length of the radius-rods of the parallel motion is the distance from the point of attachment on the cross-head or side-rod, when the piston is at half-stroke, to the extremity of the radius-crank, when the crank is horizontal; or, in engines with the parallel motion attached to the cross-head, it is the distance from the centre of the pin of the radius-crank, when horizontal to the centre of the cylinder. Having fixed the centre of the parallel motion shaft in the manner just described, it only remains to put the parts of it together when the motion is attached to the cross-head; but when the motion is attached to the side-rod, the end of the parallel bar must not move in a perpendicular line, but in an arc, the versed sine of which bears the same ratio to that of the side lever, that the distance from the top of the side rod to the point of attachment bears to the total length of the side rod.

The parallel motion when put in its place should be tested by raising and lowering the piston by means of the crane: first set the beams level, and shift in or out the motion-shaft plummer-blocks or bearings, until the piston-rod is upright. Then move the piston to the two extremes of its motion: if at both ends the cross-head is thrown too much out, the stud in the beam to which the motion side-rod is attached is too far out, and must be shifted nearer to the main centre: if at the extremities the cross-head is thrown too far in, the stud in the beam is not out far enough. If the cross-head be thrown in at the one end and out equally at the other, the fault is in the motion side-rod, which must be lengthened or shortened to remedy the defect.

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## Art. X.—NOTES OF THE MONTH.

*Condition of Railways.*—A severe railway epidemic has been succeeded by a dangerous depression, and the speculators are now as anxious to get rid of railways as they formerly were to be favoured with allotments. Matters have come to such a pitch that the ministry has brought in a bill to facilitate the winding up of railway schemes. It provides that no bill shall be read a third time unless it be certified that it was approved by a meeting of scrip or shareholders convened for the purpose, and of which due notice had been given in the official and other newspapers. The amount of scrip or shares required to constitute the meeting is one-third of the whole capital, and only scrip which was issued or the deposits on which were paid before the 31st of March, can qualify for voting; and three-fifths of the scrip or votes present must approve of the project. The fresh votes of an adjourned meeting may be added to those of the first meeting as if they were one and the same. The several particulars enumerated or involved in the proceeding, must be minutely specified, and receive the signature of the chairman of the meeting, and of the solicitor and parliamentary agent of the company.

The reason for the interference is the immense amount of capital which the railway schemes would absorb, and which from the increased prices of materials and labour wold exceed the estimated expence; and the depression in the value of shares in the market. Ths total amount of capital required for bills under consideration on the 11th of April is not less than 304,000,000*l.* The amount of railway capital in 1845, was 60,849,000*l.*, and in 1844, 17,987,000*l.* This comparison shows the extent of the speculations which have deranged our monetary affairs, and its vast excess above the sums which in former years were sufficient to cause distress and embarrassment. From such facts a justification may well be drawn for legislative interference; and the only fault, we conceive, consists in not having taken decisive steps at an earlier period to grapple with the difficulties of railway legislation, instead of reserving them till a time when a vast amount of money had been prodigally and uselessly expended, and business, sufficiently endangered by other measures, had been materially impaired by the recklessness of speculators. We sincerely trust that the experience of this season of gambling and consequent depression will induce our legislators to provide against the recurrence of the evils.

The system of *laissez faire*, though exceedingly well adapted for ignorant or time-serving politicians, is not one which can be implicitly followed by a statesman: it is too philosophical for the ordinary affairs of life, while conducted by ordinary men, and can only be considered as a safe general guide to be slightly modified by the circumstances and exigencies of the moment. It is no doubt true that there is a self-adjusting power operating through every department of the social economy, and any departure from right principles will put forces in operation which will eventually effect a restoration; but it must not be forgotten that a penalty must in every such case be paid proportioned in severity to the extent of the deviation. True wisdom then will manifest itself in preventing such dangerous eccentricities, instead of allowing them in the complacent belief that they will be repented of after much mischief has been occasioned.

*Government Patronage of the Arts.*—The Belgian Government in its anxiety to promote the trade of the country, have imported some barrels of Venetian nails, which are held in high esteem in the Levant. These are exhibited to all who are interested in the subject, and to aid manufacturers a full detail of the manner of making them has been obtained. Such a fostering care on the part of our government is not to be expected, nor would we much regret industry being left to its own resources, if it were only permitted perfect freedom untrammelled by ruinous fiscal restrictions.

*Communication with the Pacific.*—The government, it is stated, has concluded a contract with the Pacific Steam Navigation Company for the conveyance of the mails from Panama to Peru and other parts of South America. In the United States a railway has been projected from Michigan to the Pacific, and a memorial on the subject has been presented to the senate, who are expected to report upon the scheme at an early day. Mr. Whitney, after setting forth the advantage which must result to the United States by the construction of such a railroad—first, by immediately connecting them with Oregon, and thereby securing the commerce on the Pacific, the Indian Ocean, and the Chinese seas, by giving to them the commerce of more than 700,000,000 people—glances at the general importance of railroads, and the hold which England possesses over the commerce of India and Asia. He next shows the advantages to be derived by the United States, in being enabled to compete with England in the Asiatic trade, and in opening an intercourse with China, which this projected railroad is calculated to effect; and then dwells on the facility of construction, on which he speaks confidently, having personally inspected above 700 miles of the proposed route during the last summer; he gives a detailed and interesting account of his own explorations, and those of others, commencing at the borders of Lake Michigan, thence to the Mississippi, Milwaukie, Prairie du Chien, the Cedars, Council Bluffs, to the terminus of the proposed route on the borders of the Pacific, after penetrating through the Oregon territory. He next points the attention of Congress to the progressive movements of New England, New York, Pennsylvania, Maryland, and Virginia—which states are all pushing their railroads into, or in the State of Ohio, where they will all meet, and form one grand line, to join this road where it proposes to cross the Mississippi, or between that river and through Lake Michigan. Mr. Whitney states, that his projects would bring the extremes of the globe together in thirty days, and that a cargo of teas could in that event be delivered in any of the Atlantic cities in thirty days, or in London in forty-five days. Such a project, he maintains, would revolutionise the commerce of the world, place the United States directly in the centre of all, and be a means of civilizing mankind. The total estimated cost of this road, when completed and in operation, is 65,000,000 dollars, and to accomplish this, he proposes the grant of 92,160,000 acres of the public domain, and the appointment of commissioners, to give titles and receive money for the sales of lands, or labour as an equivalent, thus holding out an inducement to settlers to fill up the vast unpeopled regions of country along the proposed line. It appears to us that though this railway might be of much advantage to America, it can never become the high-way between Europe and the East. The Russian railways have a far greater chance of such a distinction, though a railway through Constantinople will probably be the eventual channel.

*The Steam-ship "Pottinger."*—This is an iron steam-vessel of large size lately launched from Mr. Fairbairn's yard, at Millwall, for the Peninsular and Oriental Steam Company. We gave the specification in full at page 196 of our second volume, and we can now only briefly enumerate the principal dimensions:—

| | Feet. | Inches. |
|---|---|---|
| Length between the perpendiculars ... ... | 209 | 0 |
| Length on the spar deck ... ... ... | 218 | 0 |
| Breadth of beam for tonnage ... ... ... | 35 | 0 |
| Depth from under side of spar deck to the top of floors in engine-room ... ... ... | 28 | 9 |
| Height between passenger decks ... ... | 7 | 6 |
| Launching draught of water forward ... | 8 | 6 |
| Launching draft of water aft ... ... ... | 8 | 10 |
| Load draught ... ... ... ... ... | 16 | 0 |
| Load displacement ... ... ... | 1900 tons. | |
| Horse power ... ... ... ... | 450 | |

The *Pottinger* is the largest iron ship yet launched, with the exception of the *Great Britain*, but the Peninsular and Oriental Steam Company have three more of the same size on the stocks, and nearly ready, of which one is building by Messrs. Vernon of Liverpool, and two by Messrs. Wigram of Blackwall. The beams and keelsons are of iron, and the weight of iron in the hull is estimated at 650 tons. We have already given a drawing of the engines, which are of the oscillating kind, by Messrs. Miller and Ravenhill, and they contain many improvements.

We have inspected the *Pottinger* since she was launched, and are bound to say that the quality of the work does not come up to what we should have expected from Mr. Fairbairn. Of the quality of the material used we cannot say anything, and we do not doubt that it is of the best description; neither could we say that the work is not substantial; yet, to our apprehension, it more resembles the work of a blacksmith than of an engineer; and the quality falls very far short of that of Messrs. Miller and Ravenhill, Mr. Robert Napier, and many other makers. We observed too that the rivets attaching one of the water-tight bulkheads to the vessel's side are put so close together, as nearly to cut the vessel asunder in that place; and this we cannot help regarding as so serious a defect, that we think the plates should still be taken out and new ones substituted. Our observation was cursory, and therefore we are unable to say how far the fault we have mentioned extends, but the impression created by our visit to the vessel has been one of disappointment, and we do not think the vessel is a safe one as she at present stands.

*Strikes of Workmen.*—The principal towns have been, for some weeks back the scenes of formidable strikes, which have greatly impeded the progress of some important works, and entailed much suffering on the workmen, and considerable inconvenience and loss to their employers. The objects of these movements are, in some cases an advance of wages, and in some a diminution of the hours of labour. At Liverpool about four thousand in the building trades are out of employment:—Carpenters and Joiners, 1,700; Bricklayers, 300; Bricklayers' labourers, 400; Plasterers 200; Slaters, 130; Labourers to two last, 300; Painters, 150; Plumbers and Glaziers, 200; they have expressed a firm determination to resist the demand of the masters, that they should cease to be connected with any Trades' Union. At Runcorn, a strike was occasioned by a master insisting on the signature, by his masons, of a declaration that they were not members of any trades' unions, or contributors to their funds. At Manchester a similar contest is being carried on; the workmen out of employment there are estimated at above three thousand, all engaged in various departments of building. The masters have combined to resist the demands of the workmen, and have issued placards for 4,000 mechanics, at the following wages, in Manchester and the neighbourhood:—Carpenters and joiners, 28*s.* per week; bricklayers, 30*s.* per week; plumbers, 27*s.* per week; slaters, 26*s.* per week; plasterers and painters, 26*s.* per week; and labourers, 18*s.* per week. At Birkenhead, upwards of one thousand masons and carpenters have struck for an advance of four shillings a week. The carpenters and joiners of Leeds threatened to strike for an advance of two shillings a week. The Birmingham masters have combined, and are using their influence to stop all buildings in progress, with the view of cutting off the supplies of the refractory; they deny that the state of trade, or the price of provisions is such as to justify the demand for increased wages. The tin-plate workers of Birmingham have struck against a proposed reduction of twenty per cent. The carpenters and joiners of Redditch have struck for an advance of three shillings a week on last winter's prices. At Rhymany iron-works the men have struck for an advance. The painters of Carmarthen struck, for an increase of wages, which was amicably conceded by the masters. There is something wrong in the present relations of masters and men, which seems to entail a continual hostility; or at the best, a suspicious truce, which each party waits for a favourable opportunity of infringing. We are convinced that it is by no means a necessary state of things, but its removal involves some sacrifices of a temporary nature, which we fear will not be speedily submitted to. We are not disposed to throw undue blame upon either party, we believe both to be much in the wrong; and that the wisest course for both would be, an identification of interests, which would insure mutual respect and mutual forbearance.

*Steam-boat Engineers.*—The report of the Committee appointed to inquire into the circumstances attending the loss of the Great, Liverpool Steamer has now appeared, and we feel therefore at liberty to make some remarks upon the conduct of the engineer on that occasion. This we should have done last month, had we not thought it probable the report of the Committee would touch upon the subject, and we did not wish to anticipate their conclusions. We learn from the most credible sources, that when the vessel struck—and when it might have been expected that Mr. Wright, who is a great stickler for the advancement of the engineers to a higher position, would have striven by his energy and courage to justify the claim—that instead of labouring to the last in the engine-room to keep the water under, and stimulating both by exhortation and example, the men under him to do their duty, that he was the first person in the ship to take to the boats, whither he was followed by the whole of the engine-room crew, with the exception of one of the four engineers, and one fireman. One of the quarter-boats had been stove by a sea, and only the other quarter-boat was left for conveying ashore the whole of the passengers and every one on board the vessel; yet this one boat was seized upon by the chief engineer and his subordinates, and if they had been able to effect a landing, every one on board the vessel must have been lost, as the boat in that case would never have been brought back. Fortunately the surf was sufficiently great to deter these magnanimous deserters from attempting a landing, and they then came back to the vessel to request that some of the sailors might be sent with them to enable them to land in safety! This was of course refused; they were with difficulty induced to leave the boat; and in the boat thus providentially recovered the whole of the passengers and crew were subsequently landed. We confess we learned the particulars of this scandalous case of cowardice with a sense of humiliation, and we believe the steam-boat engineers thoughout the country will participate in the sentiment. To what end do respectable engineers toil and suffer to improve their position—to what end do they put forth their energies and exert their skill for the salvation of life and property, which as these pages testify they have successfully done—if dishonour is to be brought upon their name, and they are to be held up to the world's scorn by the misconduct of those who clamour the most loudly for the rewards of merit? Is it at the present moment, when the engineers of the navy are moving heaven and earth to raise themselves to a more becoming rank in the service, that such treason to the cause of progress is to be tolerated? Are their efforts to be for ever made fruitless, and are they for ever to be covered with shame by such glaring breaches of duty, and are the arguments raised by the opponents of their elevation to be for ever recruited by such significant lapses? It is the class of steam-boat engineers who suffer the most severely from the perpetration of such faults, and we trust they will show a becoming sense of the injury by their demeanour towards the culprits. What would be said of a captain who on the first appearance of danger went off with the only boat, and left the crew and passengers to certain destruction? And does an engineer, guilty of such an act, stand in any degree more excusable? Mr. Wright has yet to learn that life is but of little value when purchased by disgrace; the coward commands no man's sympathy, even when he only sacrifices his duty to his life; but what shall we say of him who not merely runs away from his duty, but is willing to sacrifice hundreds of other lives in his miserable attempts to escape? Such a man is a disgrace to his calling, and he who can in any way countenance either him, or any other of the band of deserters, requires an apology for himself.

*Railway Sinuosities.*—There can be little doubt that eventually we shall have direct lines of railway between the most important points of the empire. That some delay may elapse is not improbable, inasmuch as it will be some time before we shall have sufficiently recovered from our present monetary debility, and before the opposition of the existing lines shall have been overcome. The defective routes of many of the present trunk railways may be conceived from a few instances which have been given in the *Times*. The traveller from London to the western counties is carried almost into the middle of England, and loses thirty-six miles by the time he reaches Exeter. The traveller to Cheltenham and South Wales loses still more in proportion. The traveller in Scotland and the North of England loses fourteen miles by the time he gets to Derby in sheer distance alone, besides the delay inseparable from junctions. The traveller to Lincoln, even by the line now in progress, loses an hour and a half; and the traveller to Peterborough, or to Norwich, nearly an hour. The traveller to Dover is carried half-way to Brighton; the traveller to Maidstone goes about twice the turnpike distance; and the traveller to Portsmouth goes twenty miles out of his way, to the west. The great lines are attempting to disguise the fact of their devious routes by the parade of express trains. That, however, is a mere practical fallacy. If the lines were more direct, the expresses would be still more expeditious, and government is as much bound to consult the convenience of the penny-a-miler as of the select few who can afford to travel at forty or fifty miles an hour.

*Mr. Barry and Dr. Reid.*—The disputes between Mr. Barry and Dr. Reid respecting the ventilation of the new houses of parliament, have risen to such a pitch, that the select committee appointed last February to consider the state of the houses, have agreed to the following resolution:—"That it appears expedient to this committee, adverting to the differences which have existed between Mr. Barry and Dr. Reid, to recommend the following arrangements for carrying out Dr. Reid's system of ventilation and warming in the new palace of Westminster; namely, that in the event of any objection being made by Mr. Barry to the plans of ventilation and warming submitted by Dr. Reid,—or, in the event of any difference arising between Mr. Barry and Dr. Reid, either as to the amount of information requisite for the preparation of these plans, or in their execution, or otherwise, such difference shall be referred to a third party; that such third party shall finally decide upon such difference or objection; and that, subject to such decision, Mr. Barry be directed to carry into effect the plans submitted by Dr. Reid; that the third party shall be constituted as follows:—that is, that it shall consist of one person appointed by Mr. Barry and one by Dr. Reid, subject in each case to the approval of the Chief Commissioner of Woods, &c., and that in case it shall be necessary to appoint an umpire, such umpire shall be appointed by the Chief Commissioner of Woods, &c." Dr. Reid's system is, we fear, cumbrous and expensive, but many of its faults probably arise from the want of cordial co-operation on the part of the practical men with whom he happens to be associated. Dr. Reid cannot be either a practical builder or proficient engineer; and, unless zealously supported by some practical man, he cannot be expected to carry his system judiciously into practice. At page 52, of our second volume, we stated that we thought Dr. Reid carried his ventilation a great deal too far, and that a smaller supply of air than he thought necessary, would be found more comfortable and more salubrious. This opinion subsequent experience has confirmed; nevertheless, it cannot, we conceive, be doubted, by competent judges, that Dr. Reid's system is, in the main, a just one. No one disputes that buildings should be ventilated in some way or other; and if air has to be admitted and discharged, it is obviously better that it should flow in and flow out by a multitude of channels, whereby draughts will be prevented, rather than by one or two. The diffusion of the air is the grand peculiarity of Dr. Reid's system; he, perhaps, carries the diffusion to a needless extent; and he appears, in his operations, to have a very inadequate conception of the value of money, yet we hold his general views to be right, and they must prevail, in spite of all the vituperation now directed against them. Dr. Reid would do wisely to engage some skilful practical assistant, to undertake the application of his system, whom the architects could neither bamboozle nor put down; and he should also, we conceive, be content with a less vigorous airing; for, in the too large admission of air, whereby draughts are occasioned, much of the present outcry against his plans has originated. If Dr. Reid neglects the suggestion we have here offered, we fear he will be overborne, and the art of ventilating will be thrown further back than if he had never meddled with the subject.

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## Art. XI.—NOVELTIES IN ART AND SCIENCE.

*Mineralogical Caverns.*—Two interesting mineralogical caverns have lately been discovered; one near Inverness and the other at Gibraltar. The Gibraltar cavern was discovered by the Chief Justice, near whose house some labourers were digging, when an opening was perceived into a subterranean cavern, into which the Chief Justice and some other persons descended. From the roof of the cavern beautiful white stalactites depended, and among them was a human skeleton, sticking fast to the rock, and the bones of a dog beside it, both petrified. The water has dropped on the lower jaw till it has run down and hardened, giving it the appearance of a beard. The scalp still remains, and the veins on the left side are very distinct. The stone is chipped here and there, so that the bone of the skull appears through very white, in some places like ivory. The bones of the right hand were fastened to the right side of the head, so that the poor creature has the appearance of having laid down and died, very probably of starvation, with his hand under his head, which is half turned round, as if he or she had been looking up. The entire set of teeth were beautifully perfect, but the front ones of the lower jaw dropped out when it was moved.

The Inverness cavern is at a place called Abriachan, about seven miles from Inverness, and was discovered by the improvement of a road leading from Inverness to Fort Augustus. The entrance, which is visible from the road, has the appearance of a door, sloping backwards with the angle of the mountain, which the cave penetrates for about 21 feet in a horizontal direction, varying in height from six to ten or twelve feet, and from one to two yards in breadth. The roof in one part has a dome-like form composed of shattered rock, through which water oozes. At the extremity of the cavern there is an opening in the rock running inwards two or three yards, completely encrusted with stalactites, together with pieces depending from the roof: the whole is formed by water containing carbonate of lime, with carbonic acid, trickling through the crevices. Those hanging from the top are common stalactites, and the flat masses formed on the floor are termed stalagmites. Some portions of the flat pieces present the appearance of small prisms in combination. The act of cutting through the rock has shaken off a great part of the deposit. Scattered among stones, large pieces have been found of different kinds, some of the long masses varying in size from half an inch to three inches in diameter. Two specimens found at the edge of Lochness are in length eight inches each, two and a half inches thick, and weigh six pounds; they are perforated through the entire length by a small hole, which appears to have served as a duct for the carbonated water. The colour is of a yellowish white. When fractured, the long round pieces appear formed of distinct layers, slightly but beautifully varied in colour, and spreading in circles from a centre.

*Dangers of steam heating apparatus.*—An alarming accident lately occurred at Exton Church. Just as the congregation had assembled for divine service in the morning a loud hissing was heard in the chancel, which proceeded from one of the pipes by which the church is heated; the noise gradually became louder, and terminated in explosion, the steam bursting forth with great force, and the dense atmosphere rendering it impossible to ascertain the extent of danger in which the congregation was placed. The screams of the women added to the confusion, and a simultaneous rush having been made to the different doors in order to escape, numbers were thrown down and trodden upon. Those who were fortunate enough to reach the churchyard were in a fainting state, requiring assistance which they could not obtain, and those inside were crying loudly for help. Fortunately no lives were lost, and the injuries received were not of any great magnitude. Great fears were entertained for the children of the female Sunday school, a portion of whom sat in the chancel, and who at the time of explosion were enveloped in smoke and steam; but after the church became partially cleared of the steam they were discovered huddled together in a corner against the altar, a few of them only being slightly injured. The accident is stated to have had its origin in an accumulation of foul air in the expansion pipe, but this is an impossible hypothesis. The truth we suppose is that that the cap of the expansion pipe was blown off, and we presume that Perkin's heating apparatus was the one made use of. This contrivance is one that is attended with considerable danger; the temperature of the pipes is so high that they will set fire to combustible substances, and the pressure within the pipes is also very great, so that if they burst or become deranged as in the present instance, an explosion takes place, which, though it is not likely to blow up the building, may scald and greatly alarm the persons present at the time. If Perkin's apparatus be used at all, it should be situated in a vault or out-house, and the hot air should be led into the building by suitable tubes.

*Steam Navigation Bill.*—A bill is at present in progress for the regulation of steam vessels, which will contain the following provisions:—Sea-going steam vessels fitted with paddle wheels, to be fitted with paddle-box boats, and screw and sailing vessels to be fitted with boats in proportion to their tonnage. Every steam vessel meeting or passing any other steam vessel, to pass as far as may be safe on the port side of such vessel; and every steam vessel navigating any river or narrow channel, to keep as far as practicable to that side of such river or channel which lies on the starboard side of such vessel. The master or other person having the charge of any steam vessel in any river or narrow channel in Great Britain or Ireland, or the adjacent islands, or upon the sea within certain limits of any coasts of Great Britain or Ireland, whether under weigh or at anchor, between sun-set and sun-rise, to exhibit certain lights. The owner of any steam vessel in which such light shall not be exhibited, will not be entitled to recover recompense for damage which may be sustained in consequence of any vessel running foul of her during the night. The master and his employer to be liable for any damage to person or property which shall be sustained in consequence of the non-observation, as respects any steam vessel, of the rules. A declaration to be made to the Board of Trade twice a year by owners of steam vessels, as to the sufficiency and good condition of the hull of such steamer, under the hand of a competent ship-builder; and a declaration of the sufficiency and good condition of the machinery, under the hand of a competent engineer. The Lords of the Committee of the Privy Council for Trade, on these conditions being complied with, to register and transmit to the owners, certificates of the sufficiency and good condition of their steam-vessels. Should, however, the owners certify to the Board of Trade that their vessels are abroad at the time of the required declarations—that is to say, for the whole of the months of April and October, and still are in foreign parts whence it is impossible to obtain the aforesaid declarations, but shall forward the same, bearing date not more than seven days before the departure of such vessels, then the Lords of the said Committee are to give a certificate to such effect, and it will be unlawful for steam vessels to go to sea without such certificates, and officers of Customs are not to clear out vessels except they produce such certificate. Accidents and losses sustained by steamers to be immediately reported, by letter, to the Board of Trade, with every particular thereof, that the said Board may, if it should so choose, investigate the matter; the total loss of steam vessels also to be reported.

In reference to this bill we have to object against the use of paddle-box boats being made compulsory in paddle wheel steamers, when the preponderance of opinion among naval architects and other authorities entitled to respect, is certainly in favour of some other arrangement. The use of efficient life-boats of some kind or other should be made compulsory; but paddle-box boats are not the only possible expedients of safety for paddle wheel steamers, as indeed is virtually acknowledged by the permission to use other boats in the case of screw vessels, and it is a monstrous thing that an act of parliament should be made the instrument of forcing a futile patent into use, or become a pretext for taxing the community for the fame or profit of an individual. As regards lights we think it very proper that all steamers should be compelled to carry them, and also that some uniform system should be enforced, but the obligation to be a just one, should also extend to sailing vessels. We approve of a government inspection of steam vessels, so far as to establish something like an assurance that vessels are kept in good order, and, although it is certainly impossible that a casual inspection such as could alone be accomplished by a visiting engineer could be a guarantee against every imperfection, yet the mere consciousness that an inspection was to be made would be a stimulus to the engineer, and would be the means of introducing greater order and greater circumspection. The interference however prescribed by the present bill, is as we conceive needlessly frequent in the case of new vessels, which cannot be supposed to fall into disrepair within six months from the time of their construction. If the certificates of the makers of engines be accepted, we fear that the jealousy subsisting between the Scotch and English engineers, will be increased, as but a small proportion of the steamers constructed in Scotland are employed in that country; and the Scotch engineers, we are sure, will not be satisfied for the English engineers to sit in judgment on their work. This scene of jealousy is only to be overcome by the admiralty nominating a certain number of inspectors who are not engine makers, and any of whom may be selected by the proprietors of steam vessels, just in the same manner as pilots are chosen.

*Engine-room Signals.*—A drawing has been sent to us of a contrivance for communicating signals from the deck to the engine-room of a steamer, consisting of a pair of dial-plates, one on deck and one below, each furnished with a hand, which may be set at the words "stop," "slow," &c., which are written on both dials. The hands are connected together by an upright spindle and pair of bevel wheels; when the hand on deck is set to any word the hand below points to the same word, and a bell is rung to draw the attention of the engineer at every time the position of the hand is changed. This contrivance has been introduced into the *Victoria and Albert* steam-yacht, and some other vessels: it has been patented by Mr. Hughes, and is said to have been improved by Captain Crispin—though we can hardly understand what change could amount to the dignity of an improvement in so trivial an apparatus. Dials of this kind are not new conceptions; they were used in some steam-vessels long ago, but unless nursed by some captain, whose crotchet they were, they have always fallen into neglect and been discarded. We wonder that people can be found to take out patents for such trifles: any bell-hanger could put up such a handle, without the smallest tax upon his ingenuity, and would hardly think it any compliment to record his success.

*Oval Drawing Instrument.*—Mr. D. R. Hay, of Edinburgh, has invented an instrument for drawing egg-shaped ovals. It consists of a board with a spur wheel in the centre, which works upon a toothed rack, and is put in motion by a lever with a stop along its centre, to receive the pencil. Two studs are fixed in the board and another on the end of the toothed rack, which are the three foci of the figure. Another stud is fixed into the board on the outside of the focus that lies at the narrowest end of the intended oval. If the curve at this end is to be acute, this stud will be fixed very near the focus, and the further from the focus it is fixed the more rotund the oval will be. A flexible cord is then tied tightly round these four studs, the last of which is then removed; the point of a pencil is inserted into the slot, and within the cord, which it is made to tighten round the three remaining studs by drawing the point of the pencil towards the moveable end of the lever, which is then moved round upon its axis, the cord being kept tight. The pencil will thus trace upon the board one half of a perfect egg-oval; because the motion of the focus at the end of the rack increases fluxionally the two radii of the curve. Since this instrument was invented he has made another, which by means of two racks, will form both sides of the oval, by one continuous line.

*A new Aerial Machine.*—It appears, from the New York *Mirror*, that a Mr. Patten, of Virginia, has projected the construction of a steam-balloon, which he contemplates will be able to carry despatches from the shores of the Atlantic to the Oregon in the course of a few hours. He proposes, moreover, to furnish his balloon with a battery of great power, which could annihilate a hostile army, by showering balls upon it as thick as hail-stones. He expects, that a select committee of the United States legislature will be appointed to test the invention, by a trip to Texas and back. The scheme, it is hardly necessary to add, is altogether futile, as a beneficial means of communication between distant places, for it is impossible that a balloon can go against the wind, or be propelled through a still atmosphere with any considerable velocity.

*New Lacker.*—Messrs. Sedgwick and Taylor, of Piccadilly, have invented a new lacker, which gives an effect equal to that of gold, from which it cannot be distinguished by the most experienced eye. This lacker is said to be less liable to tarnish than ordinary gilding, and to be only one-seventh of the price. Specimens were exhibited at a recent *soiree* of the British and Foreign Institute, one of which was partly gilt, and partly lackered by the new process, and it was found impossible to discern the junction.

*Adamson's Rotatory Engine.*—A rotatory engine has been contrived by Mr. John Adamson, a workman in the employment of Messrs. Rennie, which, in the details of its construction for preventing friction and leakage, is, we think, one of the best yet brought before the public. This engine in its main features resembles that of the Earl of Dundonald, of the existence of which contrivance, however, Mr. Adamson was ignorant at the time he contrived his engine, but it is greatly superior in the details. The flaps are so made that they cannot by pressing too hard upon the revolving piston, occasion inconvenient friction: they are moved by a cam upon the revolving shaft on the outside of the engine, and the act of reversing the engine locks up the flap which is usually in operation, and leaves the other flap at liberty which had been locked before. An expansion valve is fitted to the steam port so as to enable the steam to work expansively, and the ends of the piston and its bearing point against the interior of the cylinder are fitted with metallic packing. It appears to us that this engine would work efficiently at moderate speeds, though we do not think it is likely to supersede the cylinder engine. In these opinions Mr. Adamson concurs, but he thinks in some cases its use may be more convenient than the cylinder engine, and in such cases only would he recommend its application.

*Baking Bread by Steam.*—A machine for baking bread by steam, has been invented by M. Violette, and is described in a late number of the *Moniteur Industriel.* It consists of two concentric cylinders, the space within which is filled with high pressure steam. The dough is placed within the internal cylinder, and the steam is then admitted into contact with it—the mass of dough having been previously pierced with small holes to enable the steam to penetrate. The object of the outer cylinder is to prevent the dough from being made wet by the steam, as would be the case if there were any material condensation. The bread is said to be baked in the course of half an hour.

*Iron Houses.*—An iron market-house has been constructed for the Honduras, by Messrs. Edington of Glasgow. It is 108 feet long, 60 feet wide, and is surrounded by a verandah 12 feet wide, supported by fluted columns. The main building contains numerous stalls for the sale of various commodities, and is ventilated by means of jalousie blades, fixed in the manner of Venetian blinds, and by a ventilator on the top.

*Musical lullaby and alarm.*—A Bohemian mechanic has contrived a clock which will give the alarm at any required hour, by playing a sonorous march of Spontoni. He has also made a bed, the pressure upon which causes a soft melody of Auber's to be played as a lullaby.

*Cultivation of Cotton in India.*—At a late meeting of the Asiatic Society Dr. Royle communicated some extracts of a letter from Dr. Wight, dated 21st January last, relative to the progress which the cultivation of cotton is making in India, and showing a degree of success and magnitude of produce far exceeding what had been expected. He stated that 30,000lbs. have been already gathered; and that "one field of which regular accounts are kept, has already yielded 700lbs. per acre and is not half done yet." In another extract he strongly recommends the English merchant to purchase in the local markets, through European agents; and to be on his guard against the universal native practice of mixing the cottons of different qualities and prices by which no first-rate cotton ever reaches Europe from India. Dr. Wight concludes with the expression of his expectation that the American cotton will soon be extensively cultivated in India. The East India Company is at present causing improved saw gins for the separation of cotton from the seeds to be constructed, and is promoting the improved cultivation of this important article of commerce.

*Method of bending the plates in iron ship-building.*—Mr. J. Watchman, of Baltimore, M.D., is stated to have invented a machine for bending iron plates for ship-building. It is formed by a combination of screws, so that the surface may be altered to suit any curve. The lower bed of screws is first arranged to suit the pattern wanted, and then the upper ones run down or up to match. The upper plate with screws is raised, and the sheet heated and laid in, and is pressed between the two until cold when it is ready for use. So far as we can understand the description, the contrivance appears to us to be a very imperfect one. The bending to be susceptible of useful application must be accomplished by means of rollers, and if that be done, the heating of the plates may be dispensed with. We have, on various occasions, suggested the plan of machine by which the bending of plates to any twist or curve, by means of rollers, may be accomplished, and we have some remarks upon the subject in another part of the present number.

*The Nebular Theory.*—Sir William Hershel's theory of the nebulous formation of stars has received a shock from some of the celestial revelations of Lord Rosse's large telescope. That astronomer has written to professor Nichol, of Glasgow, stating that the nebula of Orion which had been greatly relied, as evidence of the correctness of the nebular theory has been seen to consist of numerous stars.

*Explosion under Ice.*—At Rocheport, in Missouri, a sudden upheaving took place in one part of the lake by which a quantity of mud and numerous fish were forced up through the ice, with which the lake was covered. The eruption was attended with a loud crash; the water was about ten feet deep.

*Copper Mines in Canada.*—The *Cambrian* states that some of the British officers in Canada have lately made an important discovery of some of the richest copper mines in the world, and that the discovery has created great excitement. Some of the officers *en route* to England, carry with them specimens of ore; and among them is one piece weighing 2,200lbs. The ore is very rich, yielding 72 per cent. of pure copper. Part of the copper ore was taken from the bed of a river, and some of it was broken off a cliff on the banks.

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## Art. XII.—THE SOCIETIES.

Institution of Civil Engineers.—*March 24th.*—The paper read was by Mr. W. Parkes, Assoc. Inst. C. E., describing the "Estuary of the river Severn,"—after giving a brief account of the Severn above Gloucester, the paper proceeded to describe the character of the river at Longney Point about 10 miles below Gloucester where it becomes a tidal estuary, and where the most important circumstance to be taken into consideration as regards navigation is the rise of the tide. Below Longney the river becomes broad and shallow, and at low water presents an extensive series of shoals composed of mud and saud. The stream there is rapid, and the general fall of the surface is much increased. This lower portion of the Severn forms a great natural weir which the shipping avoid by taking the Berkeley Ship Canal.

Viewed in reference to its tides, that portion of the river might be considered as part of the Bristol Channel, for it is from the funnel shaped form of that arm of the sea that it derives its facilities for navigation: in consequence of this form the water running up is, as it were, choked by the downward current, and is raised above its sea level: thus the lift of a high tide at Kingroad is 47 feet, at the Old passage it is 45 feet, at Chepstow 37 feet 10 inches, and at Beachley 40 feet 6 inches. At this latter point is situated the Old or Aust passage on the main road from Bristol to Wales; the Channel for navigation aud the main set of the tide is close to the North or Beachley shore. The flood tide flows at about $6\frac{1}{2}$ miles an hour, and lasts $4\frac{1}{2}$ hours, the ebb $7\frac{1}{2}$ hours. Small vessels are enabled to pass up at $1\frac{1}{2}$ hours after flood tide commences, larger vessels soon after half flood, and reach Sharpness Point, the entrance of the Gloucester and Berkeley Canal, before high water: above Sharpness Point the river at low water presents an immense extent of sandy and muddy shoals for 5 miles. Here is first observed the curious phenomenon called the "Bore":—the impetuosity with which the two currents meet, and the shallowness of the low water channel, cause an almost vertical rise of 2 or 3, and sometimes 5 feet extending across the river and varying its velocity as it passes over deep or shallow water.

The paper then proceeded to notice the capabilities of the lower part of the Severn for improvements; and stated, that one of the improvements of which it was susceptible was cutting a canal across the neck of land from Framilode to Aock Crib, which would much facilitate the downward trade by effecting a saving of two tides to vessels sailing in that direction; any general scheme of improvement was scarcely practicable, as, if the natural impediments in the lower part of the river were removed, the effect might be to nearly drain the upper portion. Still some local alterations might be advantageously made, and the navigation would be facilitated.

The author seized the opportunity of suggesting the advantages of having one standard height as a uniform datum line all round the coasts of Great Britain, to which standard all levels should refer. In the discussion which ensued, the merits of the paper and the importance of the subject appeared to be generally admitted, and the good example given by the author in communicating to the Institution the observations made during the course of his survey of a portion of the river for Mr. Walker was particularly eulogized.

*March 31st.*—The discussion upon the paper read at the last meeting was continued, and precluded the reading of any original communications. In reference to Mr. Heppel's paper on the resistance to bodies moving through fluids, it was observed that the method of experimenting while dragging the paddles through the water was objectionable, and liable to error, from the slight knowledge we yet possessed of the actual resistance of flat bodies in fluids. Mr. Russell gave an account of the experiments tried by him on vessels of large tonnage, dragging them through the water by a steam tug, and recording the resistance by a dynamometer, the peculiarities of which he described, and exhibited the diagrams produced by it, both with steam vessels and with locomotive engines. The instrument consisted of two pairs of plate springs, of a parabolic form, as designed by M. Morin, and so proportioned as to have an equal degree of flexure throughout their length.—Four self-inking pens, with different ink, recorded upon long strips of paper wound upon barrels, all the effects of resistance, &c., by a series of curves, the areas of which were afterwards measured by a simple self registering instrument, which he also exhibited. For measuring the velocity he used "Pitot's tube;" and of its correctness he spoke in the highest terms.

Mr. Rennie's experiments on the subject were also discussed, as were also those of Colonel Beaufoy, of Mr. Palmer, Sir John Macneill, and Mr. Walker, and the various results arrived at were compared. The general result appeared to be that with regard to vessels no general law could be universal in its practical application, as it must be modified by circumstances due to the forms of the vessel, the lateral friction, and numerous causes, all of which must influence the results.

The application of the dynamometer to testing the resistance of railway trains was then discussed, and the members were generally surprised to find so small an amount of inequality of action at the starting of a train, and how soon the diagram shewed comparative steadiness of traction—still the delicacy of the instrument was such as to indicate distinctly every change of gradient, and even the entering and leaving of a cutting or a tunnel, shewing the greater or less influence of the wind.

The usual dynamometer with helical springs and pistons working in oil was shewn to be for such purposes nearly useless, as they smothered the results. It was stated that the table of the force of wind at certain velocities, as given in Smeaton's reports, was erroneous by fifty per cent; and that as the front and the lateral action of the air upon the train constituted a large portion of the actual resistance, it was necessary to make these corrections, which, when made, showed an extraordinary accordance between the calculated resistance and that absolutely recorded by the instrument. The results given (although, as yet, not sufficiently positive to be calculated for general use) shewed that a change must take place in the usual allowance for resistance on railways; these tables were promised to the institution within a short time.

In the renewed discussion upon Mr. Parkes's paper "on the Estuary of the River Severn," the extraordinary circumstances attending the tides, the "Breaking Bore," the mode of conducting the navigation, aud the improvements now executing in the upper part of the river, were fully discussed. It was suggested that one universal datum line throughout Great Britain referring to one standard—say Trinity High Water mark—would be of the greatest utility for tidal observations, and for railway purposes; and it was proposed that the institution should request the co-operation of government in accomplishing this desirable object.

*April 7th.*—The conversation upon the estuary of the River Severn being renewed, led to an interesting discussion upon the River Clyde, and the capability for improvements of that river, which has been continued at the next meeting. The paper read was a short notice by Mr. G. Buchannan explanatory of a plan and sections of the Midlothian Coal Fields. The coal field treated of, is that by which the City of Edinburgh has long been supplied, and it was stated to be very far from being exhausted, but that a very large portion of the coal seams were rendered useless on account of the vast volume of water which, percolating through the old workings, pervaded the freestone strata above the coal, and poured down in such quantities, that the pumping engines were barely sufficient to keep open the present workings; it therefore became the object of the proprietors to obtain an extensive system of drainage throughout the coal-field. Mr. Buddle, of Newcastle, was requested to draw up a report on the subject, from which it appeared that the great difficulty to be encountered arose from the circumstance, that an open water communication existed throughout the district; and a pumping-engine placed in any one spot would draw the water from every part around, which would render it an operation involving great labour and expense, which ought to be borne equally by all the mine proprietors. The paper then described the situation of the great dyke by which the coal was intersected and thrown 80 fathoms upwards at the north east boundary, where the seams are standing on edge, and then gave the different seams of coal and their qualities. These were—

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|---|---|---|
| Splint coal | 3 feet thick | good quality. |
| Rough | 3 " | ditto |
| Bufie | 4 " | inferior quality, not much worked. |
| Diamond | 4 " | valuable when found. |
| Jewel | 4 " | most valuable. |

*April 21st.*—The discussion was continued on the improvement of rivers. Mr. Bald gave at great length his views on the works of the Clyde, and particularly drew attention to the tidal flow, that no obstructions should be given to it. He entered into considerable detail regarding the deepening and improving of the River Clyde, the number of shoals which had been cut through or dredged up, and the boulders which had been removed from the bed of the channel, between the years 1839 to 1845. Particular attention was drawn to the necessity of the removal of all obstacles which impeded the tidal flow from the ocean into the higher channel and recesses of the Clyde. Reference was made to the effect of similar works on British and foreign rivers, and also to the opinions given in the reports of the several engineers who had been consulted. He particularly drew attention to the restriction of the capacity of the channel on the north side of New Shott Isle, which he contended would have the effect of diminishing the tidal flow, and cause the present south channel to be silted up. The whole details were given of the plans adopted during the last six years for deepening the Clyde from Port Glasgow to Glasgow harbour. The observations concluded with stating that in 1755 Smeaton found the Clyde on the Hunt Shoal could only float vessels drawing three feet three inches up to Glasgow harbour, while the present navigation had been so improved that ships drawing 17 feet 9 inches of water sail up to Glasgow, and a case was mentioned of a ship drawing 19 feet having ascended the Clyde last summer.

Society of Arts.—*April 8th.*—The first communication was by Dr. Green, on a new portable stand for telescopes, with an equatorial movement, but without a polar axis. The subject of the improvement which Dr. Green has made was introduced with an account of the telescope from the time of its discovery, and the various improvements which have been made upon it up to the present time. He next alluded to the stands ordinarily used by astronomers, and pointed out the peculiarities of the Herschelian, Achromatic, and other stands, and the objections to them, arising either from their unsteadiness, unportability, or other causes; he then proceeded to point out the improvements which he had effected by describing his own stand. The true principle upon which every stand ought to be constructed (Dr. Green observed) is to have the heaviest end of the telescope supported on a solid foundation, and the moving power should be placed as far as possible from the centre of motion.

As a triangular form is found to be the most steady, it has been adopted in the case of this stand. The object-end of the tube, containing the great mirror, rests upon a circular disc having a diameter about one half larger than that of the tube: it is supported by three feet which are not more than $\frac{3}{4}$ of an inch high, so that it may be said to rest solidly on the earth. To admit of easy rotation a second disc of the same diameter rests on the surface of the one already described, and moves on three friction wheels round a pivot passed through the centre of each. Near the periphery of this upper circular disc, upon the opposite sides of it, are fixed vertically two flat pieces of brass, about half the diameter of the tube in height: upon these the telescope rests by means of two horizontal arms projecting from the sides. The object of this arrangement is to form a universal joint and prevent the telescope rotating on its own axis.

The upper end of the tube rests upon a pair of shears, a little inclined towards the tube: thus the entire fabric is one large triangle possessing the greatest steadiness. The shears are attached at their lower end to a horizontal bar which slides in a groove; the bar is worked by means of a universal joint and rack and pinion, and by it the slow motion in azimuth is given. The shears are so constructed as to admit of being lengthened or shortened. The fine movement in altitude for finding a star is provided by a slide on the outside of the under part of the tube, to which slide the shears are attached. The slide is moved by a rack and pinion. The equatorial movement is the link of connection between the head of the shears and the slide for the fine altitude movement, and is thus effected:—The two legs forming the shears are hinged together at the top by a circular joint, in the centre of which is inserted a piece of brass which carries the equatorial movement slide, and is worked by a toothed wheel and pinion.

The second communication was on a process for the preservation of animal and vegetable substances, with their forms and colours unimpaired, by Le Docteur Jaques Silvestri, of Naples. The nature of the discovery was described to the meeting, and a number of beautiful specimens of preserved animal and other substances were exhibited. Specimens of a new process of dulling the surface of electrotypes, by Mr. Colchester, and also specimens of a new method of bronzing, by Mr. Loope, were also exhibited, and excited a great deal of interest.

*April 15th.*—The first communication was on Mr. Rand's inventions for the manufacture of flexible metal vessels for preserving paint and other matters by Mr. Carpmael. It was stated that Mr. Rand, who is an artist, had, from the inconvenience and waste of colour which take place when the paint is put up in the bladders ordinarily used for that purpose, been led to endeavour to find a substitute, and the use of metallic vessels presented itself to his mind. After many experiments he succeeded in forming them of so thin a body of metal that they are capable of being collapsed so as to shut out all air. The tubes are made of block tin, the 160th part of an inch in thickness; they have at their upper end a nozzle and screw cap, and are closed at the bottom by being folded over once or twice with a pair of pincers so as to exclude all air; as the colour or other matter which they may contain is pressed out, the tubes are collapsed, and thus the upper part of the tube always remains full. Each tube has to go through the following process of manufacture:—A small piece of block tin is put into a die, upon which a punch worked by a fly-wheel press descends, and forces the metal up of the required thickness between the surfaces of the die and the punch; thus by a single blow the body of the tube is formed. It is next removed to a second press, by which the screw on the neck of the tube is formed, and by a second blow in the same press the maker's name is stamped upon it. The cap is formed in a similar manner by a third machine. The tube, when struck, is placed in a lathe and cut to the required length. Thus an air-tight metallic bottle is formed without seam.

Mr. Wright exhibited a number of the tubes, which were beautifully ornamented, some of them being covered with richly embossed velvet and other materials, and filled with choice perfumes; and he presented one of the bottles to every lady present. He also stated that he had exported to various parts of the world essence of anchovies, prepared mustard, cold creams, and volatile chemical preparations. It is intended to export and import butter, preserved meats, and other substances, in cases of this description.

The second communication was by Mr. Banks, on the cotton produced in Honduras and Yucatan, and the practicability of introducing free labour cotton from Africa and other countries into the British market. The object of Mr. Banks's communication was to point out the importance of our cotton manufactures, the successful competition of white and gray fabrics with those of Britain in foreign markets, the great production of raw materials by slave labour in the States, the general inferiority of the cotton imported from India, the practicability of obtaining larger supplies by free labour from other quarters within our reach, the improvement of the staple, and consequently of the fabric, and the opening of new markets with Africa and elsewhere. In consequence of the length of the first communication there was not sufficient time to read the whole of the paper, and it was therefore announced to be resumed at the next meeting.

*April 22nd.*—The first communication was by Mr. Banks, who resumed his paper on cotton produced in Honduras and Yucatan, and he proceeded to show why the American white and grey fabrics maintained a higher price, and so successfully competed with the British manufactures in foreign markets. He next described the peculiarities of the various kinds of cotton, and the means resorted to by the Americans for cleaning or freeing the cotton from the seed by the use of the saw gin. The amount of cotton exported to England from America he stated to be 1,500,000 bales per annum, while that from India and other countries amounted to only 500,000 bales. He next proceeded to show that the sea-coast of Africa presents a large territory which is capable of being made to produce cotton in larger quantities, and of a quality equal, if not superior to the American. From inquiries which he had made at the Wesleyan and Baptist Missionary Societies he had ascertained that the missionaries of both those societies have instructions to promote such objects as the cultivation of cotton among the natives at their several stations, which extend all along the coast of Western Africa, and he strongly urged the necessity of their introducing the saw gin in lieu of the roller gin and hand labour, to free the cotton from the seed, and of the screw press for packing it into bales for exportation.

The second communication was by Mr. Keyse on an apparatus for preserving life by supporting persons when in the water. It consists of coverings for the arms which are made of Mackintosh cloth and are capable of being inflated, of a pair of webbed gloves, and also a pair of cork clogs with concave bottoms. The apparatus is stated to give an additional buoyancy of 35 lbs. to the body.

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## Art. XIII.—LETTERS TO THE CLUB.

A Budget of Receipts.—I fear you must have thought me remiss in not forwarding to you more regularly my promised contribution of receipts, but I trust for the future to be more regular.

*Threads Plated with Glass.*—Threads may be plated with glass by dipping them in the silicious solution termed "liquor of flints" made by boiling pounded flints with alkali, as in Mr. Ransom's process for the formation of artificial stone, and then neutralizing the alkali by immersing the threads in a diluted acid. Artificial horse-hair of any colour may be thus produced. But the application does not stop here; for by the same process threads of silver, gold, pearl, enamel, &c. may be produced, and fabrics of the most gorgeous description may be formed from these brilliant elements. To make gold or silver threads, take common threads, wax them until they be round and smooth; give them a coating of black lead, and then immerge in the gold or silver electrotyping solution: they may be afterwards plated with glass. Pearl threads may be made by covering the threads with the substance used in the manufacture of artificial pearls, and then plating them with glass. Blue enamel threads may be made by coating a thread with copper, oxidizing it so as to give a blue colour, and then plating it with glass. The brilliancy of all the gems of amethyst, emerald, &c. may be imitated in this manner, and flowers of appropriate hues may be woven in the fabric, which may be made to appear as if made up entirely of gold and precious stones.

*Artificial Leather.*—Gutta Percha promises to be of much use in the formation of artificial leathers. Another artificial leather may be made by steeping a very thin sheet of carded cotton in a mixture of glue and treacle, such as is used for covering printers' rollers, passing the sheet through rollers to wring out the superfluous liquid and tanning it. This process may be repeated a few times and the sheet may then be dressed in oil. If thick leather be wanted, several of these sheets may be stuck together by caoutchouc or gutta-percha, and emery or other hard substances may be added to resist the wear, if the leather be intended for soles of shoes.

*Green Transparent Varnish.*—Grind a small quantity of Chinese blue with about double the quantity of finely powdered chromate of potash, and a sufficient quantity of copal varnish thinned with turpentine. The mixture requires the most elaborate grinding, or incorporating, otherwise it will not be transparent.

*Liquid Blue.*—Put into a small matrass or common phial an ounce of Prussian blue reduced to powder, and pour over it from one ounce and a half to two ounces of concentrated muriatic acid. The mixture produces an effervescence, and the prussiate soon assumes the consistence of thin paste. Leave it in this state for twenty-four hours, then dilute it with eight or nine ounces of water, and preserve the colour thus diluted in a bottle well stopped.

*Diamond Cement.*—This cement is made of isinglass, (which is prepared from the sound or swimming-bladder of the sturgeon,) dissolved in diluted spirits of wine, or more usually in common gin. The two are mixed in a bottle loosely corked, and gently simmered in a vessel containing boiling water; in about an hour the isinglass will be dissolved and ready for use; when cold, it should appear as an opaque, milk-white, hard jelly; it is re-melted by immersion in warm water, but the cork should be at the time loosened; it may be found necessary, after a time, to add a little spirit to replace that lost by evaporation. When the isinglass is dissolved in water alone, it soon decomposes.

*Vegetable Ivory.*—Corosos, or ivory-nuts, are produced by *Phytelephas macrocarpa*, growing in central America and Columbia, (Humboldt). They are described as seeds with *osseous albumen;* the tree is a genus allied to the *Pandaneæ*, or Screw Pines, and also to the Palms. The nuts are of irregular shapes, from one to two inches in diameter, and when enclosed in their thin husks, they resemble small potatoes covered with light brown earth: the coat of the nut itself is of a darker brown, with a few loose filaments folded upon it. The internal substance of the ivory-nut resembles white wax rather than ivory; it has when dried a faint and somewhat transparent tint, between yellow and blue, but when opened it is often almost grey from the quantity of moisture, in losing which it contracts considerably. Each nut has a hole, which leads into a small central angular cavity; this, joined to the irregularity of the external form, limits the purposes to which they are applied—principally the knobs of walking-sticks, and a few other small works.

*Gold Alloys.*—Gold-leaf for gilding contains from 3 to 12 grs. of alloy to the oz., but generally 6 grs. The gold used by some dentists for plates, &c. is nearly pure, but contains about 6 grs. of copper in the oz. troy, or one 80th part; others use gold containing upwards of one-third of alloy; the copper is then very injurious. With copper, gold forms a ductile alloy of a deeper colour, harder and more fusible than pure gold; this alloy in the proportion of 11 of gold to 1 of copper, constitutes standard gold; its density is 17·157, being a little below the mean, so that the metals slightly expand in combining. One troy pound of this alloy is coined into 46 29-40ths sovereigns, or 20 troy pounds into 934 sovereigns and a half. The pound was formerly coined into 44 guineas and a half. The standard gold of France consists of 9 parts of gold and 1 of copper.

*How to dye Horn.*—Horn is easily dyed by boiling it in infusions of various coloured ingredients, as we see in the horn lanterns made in China. In Europe it is chiefly coloured of a rich red-brown, to imitate tortoiseshell, for combs and inlaid-work. The usual mode of effecting this is to mix together pearl-ash, quicklime, and litharge, with a sufficient quantity of water and a little pounded dragon's blood, and boil them together for half an hour. The compound is then to be applied hot on the parts that are required to be coloured, and is to remain on the surface till the colour has struck: on those parts where a deeper tinge is required, the composition is to be applied a second time. This process is nearly the same as that employed for giving a brown or black color to white hair, and depends on the combination of the sulphur, (which is an essential ingredient in albumen,) with the lead dissolved in the alkali, and thus introduced into the substance of the horn.

*Lithographic Transfer Paper.*—Lay on the paper three successive coats of sheep-feet jelly, one layer of white starch, one layer of gamboge. The first layer is applied with a sponge dipped in the solution of the hot jelly, very equally over the whole surface, but thin; and if the leaf be stretched upon a cord, the gelatine will be more uniform. The next two coats are not to be laid on, until each is dry. The layer of starch is then to be applied with a sponge, and it will also be very thin and equal. The coat of gamboge is lastly to be applied in the same way. When the paper is dry, it must be smoothed by passing it through the lithographic press; and the more polished it is the better does it take on the ink; or the following method may be pursued:—Take an unsized paper, rather strong, and cover it with a varnish composed of—starch, 120 parts; gum arabic, 40 ditto; alum, 20 ditto. A paste of moderate consistence must be made with the starch and some water, with the aid of heat, into which the gum and alum are to be thrown, each previously dissolved in separate vessels. When the whole is well mixed, it is to be applied, still hot, on the leaves of paper, with a flat smooth brush. A tint of yellow colour may be given to the varnish, with a decoction of French berries. The paper is to be dried, and smoothed by passing under the scraper of the lithographic press.

*Artificial Wax for Candles.*—The wax used for the manufacture of wax candles does not contain more than 2 or 3 per cent. of wax, yet it is hardly to be distinguished from genuine wax. In its manufacture the first process is to boil the fat with quicklime and water in a large tub, by means of perforated steam pipes distributed over its bottom, and by a vigorous ebullition of three or four hours, the combination is pretty complete. The stearate being allowed to cool, becomes a concrete mass, which must be dug out with a spade, and transferred into a contiguous tub, in order to be decomposed with the equivalent quantity of sulphuric acid diluted with water, and also heated with steam. Four parts of concentrated acid will be sufficient to neutralize three parts of slaked lime. The saponified fat now liberated from the lime, which is thrown down to the bottom of the tub in a state of sulphate, is skimmed off the surface of the watery menstruum into a third tub, where it is washed with water and steam. The washed mixture next is cooled in tin pans; then shaved by large knives, fixed on the face of a fly-wheel, called a tallow-cutter, preparatory to its being subjected in canvass or caya bags to the action of a powerful hydraulic press. The pressed cakes are now subjected to the action of water and steam once more, and are then ground by a rotatory rasping-machine, to a sort of mealy powder, which is put into canvass bags, and subjected to the joint action of steam and pressure in a horizontal hydraulic press, similar to that used for pressing spermaceti. The cakes are subjected to a final cleansing in a tub with steam, and then melted into hemispherical masses called blocks. When these blocks are broken, they display a highly crystalline texture, which would render them unfit for making candles. This texture is therefore broken down or comminuted by fusing the stearine in a plated copper pan, along with one-thousandth part of arsenic, after which it is ready to be cast into candles in appropriate moulds.

*Shells as Manure.*—The shell banks of Lough Foyle form when the tide is out extensive flats, which are firm enough to be walked on without any inconvenience, and they are resorted to by numerous boats for loads of shells, and though this system has been pursued for more than a century, they exhibit no appearance of a failure in the supply. The shells hitherto examined are all of recent species. There are engaged in raising the shells 235 men and 50 boys. These shells are particularly useful in bringing bad lands into cultivation, and in ameliorating stiff wet clays, deficient in calcareous matter, being applied at the rate of from thirty to sixty barrels per acre. They are preferred to lime, as warming and brittleing the land.

*How to keep Butter Sweet for Years in any Climate.*—The butter is to be well churned, and worked and packed hard and tight in kegs of seasoned white oak; the head is then put in, leaving a small hole into which brine is poured to fill the vacant space; and of so much importance is it deemed, to prevent any bad taste, that the plugs for the hole must not be made of cedar or pine, but of cypress or bass wood, as otherwise it would be injured. After which, these kegs are placed in hogsheads well filled with brine of full solution, that will bear an egg, which are then headed up tight and close.

*Seasoning Timber.*—The best instructions I have met with for seasoning timber are those long ago given by Evelyn:—" Some there are," he says, " who keep their timber as moist as they can by submerging it in water, where they let it imbibe, to hinder the cleaving; and this is good in fir, both for the better stripping and seasoning; yea, not only in fir, but other timber. Lay, therefore, your boards a fortnight in the water (if running the better, as at some mill-pond head) and there, setting them upright in the sun and wind, so as it may freely pass through them (especially during the heats of summer, which is the time of finishing buildings,) turn them daily; and thus treated, even newly sawn boards will floor far better than many years dry seasoning, as they call it. But, to prevent all possible accidents, when you lay your floors, let the joints be shot, fitted, and tacked down only for the first year, nailing them for good and all the next; and by this means they will lie staunch, close, and without shrinking in the least, as if they were all one piece. And upon this occasion I am to add an observation, which may prove of no small use to builders, that if one take up deal boards that may have lain in the floor a hundred years, and shoot them [plane their edges] again, they will certainly shrink *(toties quoties)* without the former method. Amongst wheelwrights the water seasoning is of especial regard, and in such esteem amongst some, that I am assured the Venetians, for their provision in the arsenal, lay their oak some years in water before they employ it. Indeed, the Turks not only fell at all times of the year, without any regard to the season, but employ their timber green and unseasoned; so that though they have excellent oak, it decays in a short time by this only neglect."

GATHERER, *Birmingham.*

*Improvement in Printing Machinery.*—I think I have discovered the cause of the difference in the quality of printing executed in a cylinder machine from that executed either in a hand press or tympan machine; and though the cause may be known to some printers, I have not met with any who were acquainted with it. The impressions obtained from a cylinder or newspaper machine are to a certain extent smeared, the cause of which is that it is impossible to make the table on which the type is placed move with precisely the same velocity as the surface of the cylinder, for even a variation in the thickness of the paper will, by altering the diameter of the roller, make some difference. It would be an improvement in cylinder machines I conceive, especially in those used in printing cuts, if the paper were fixed upon the table, as might be done by an appropriate mechanism instead of upon the cylinder as at present.

J. WOOLGAR, *Bath.*

*Tubular and Narrow Water Space Boilers.*—I have perused with pleasure your remarks on tubular marine boilers, page 67. One of the paragraphs there most forcibly recalls to my memory your observations on the narrow water spaces in my sheet water space boilers, and I hope you will allow me to direct your attention to it. It is as follows:—" It is very desirable that the space between the furnaces and tubes of tubular boilers should be sufficiently large to enable a man or boy to get in. The bend joining the top of the furnaces at the after end, with the bottom of the tube plate, is very liable to get burnt away, and its repair will be most difficult, unless made accessible from the inside to hold on the rivets. The boilers of the Sydenham, shown in a former number of the *Artizan,* are very judiciously formed in this as well as in most other respects; it appears expedient, however, to shield this and any other such exposed parts where the heat acts injuriously upon the iron, by means of fire blocks moulded to the place, and secured by nuts sunk into dovetailed recesses in the substance of the blocks, which recesses are finally filled up with fire clay. In new boilers even, such an application is most expedient in situations in which injury to the iron from the impact of flame is experienced or apprehended." Has it really come to this at last after a fair trial of tubular boilers, that engineers are obliged to resort to the clumsy expedient of fire blocks to prevent the plates of the boilers being burned. This is really a confession: after going to the expense of constructing tubular boilers in order that a great amount of heating surface may be obtained, engineers find that owing to the bad arrangement of those boilers, they are obliged to prevent the fire from acting on a most valuable part of the heating surface. What a contradiction! First, to be at the expense of making surface for heat to act upon, and then be at the expense of providing blocks to prevent the heat acting on the very surface made to receive it. And further, it is not only necessary to use those fire blocks, but it is necessary to increase the weight and bulk of the boilers by making the water space above the furnace so wide that a man or a boy can get into them in order to facilitate the repairs of burnt plates. The rage for those boilers is but a fashion; it will soon pass away, for they are not made on sound philosophical principles. The above quoted paragraph throws a strong light on the fact, that the burning of the metal of boilers does not depend on the extreme narrowness or the great width of the water space in contact with the burnt metal. No; the burning of the plates is caused by the bad arrangement or shape of the water spaces; the amount of water which they originally contained has nothing to do with the matter. The fact of there being a large mass of water, whilst a boiler is cold, in contact with a plate that is liable to be burned, is no proof that water will be in contact with that plate after the boiler is heated and steam is produced; steam may have accumulated next the plate and allowed it to be burned. There can be no doubt that this is what must occur in all the parts of tubular boilers, where the metal is destroyed by heat; if water were in contact with the metal it could not be burned. No engineer would ever resort to the expedients referred to in the paragraph I have quoted, if the evil could be removed by altering the shape of the faulty water space to such a form as would remove the cause of the disease; but this they cannot do, for to make the necessary alterations for that purpose would involve changes which are altogether impracticable in that plan of boiler; therefore, these boilers are incurably bad: they and their accompanying fire blocks will only be endured until the public know and appreciate the true principles according to which boilers ought to be constructed. To construct a water space, so that the plates of it shall not be burned, it is not merely necessary that the space be of such a shape that there are no projections or parts of the boiler that would interrupt the ascent of the steam; the mere orifice for the exit of the steam is not all that is required; there must also be arrangements made for a steady supply of water to the water space, and the opening through which the steam is expected to leave the water space should not be the opening through which the space is to be supplied with water, for the steam and water would interrupt each other if made to go through the same opening, for they move in opposite directions. Each water space ought to be constructed so that the steam shall get out at the upper end and a fresh supply of water be admitted at the same time at the lower end of the space. Now, if all the water spaces in a boiler which are acted on by heat be expected to deliver steam at their upper ends, then it is clear that some water space must be provided in the boiler which will allow the surplus water that is thrown up with the steam to get down again to the bottom of the boiler. Water spaces for that purpose should be provided which are not acted upon by heat, or rather which do not contain heating surface. In conclusion, the plates in tubular boilers that require to be shielded by the fire blocks. have water spaces of six and in some cases nine inches in width, and still the plates are burned; whereas the plates which you predicted would be burned off the water spaces in my boilers have now stood the test of two years' working, and they are as good as the day they were made. These water spaces are a quarter of an inch wide and two feet deep: the steam gets freely out at the top of them and there is a constant supply of water going in at the bottom of them, which is supplied by the water spaces provided for the purpose of letting the water get from the top to the bottom of the boiler. Some engineers make the feed-water enter at the bottom of the water spaces with the expectation that it will keep the spaces filled with water; but this plan is absurd. The feed to a boiler is of course capable of supplying the amount of water evaporated by the boiler, but the feed going in at the bottom of the water spaces is wholly incapable of supplying the place of the water that is thrown out of the spaces by and during the formation of the steam.

James Johnstone, *Greenock.*

[There appears to us to be a considerable air of exaggeration in Mr. Johnstone's recital of the defects of tubular boilers. In any case it is expedient to leave a sufficient space between the tubes and furnaces to enable a man or boy to get in to clean or repair the boiler when required; and as regards the attachment of fire blocks to the end of the water space, it appears to us to be a simple and inexpensive expedient and not open to any weighty objection. In any part of a boiler upon which the flame impinges forcibly, the iron of the boiler is liable to injury if the combustion be very rapid. The conducting power of the metal is imperfect; and rivet heads or double thicknesses of plate are therefore objectionable in the fire boxes of locomotives. We concur with Mr. Johnstone in thinking that in some cases it may be expedient to establish separate channels for the upward and downward currents, but we think he greatly overrates the importance of this condition; and in ordinary boilers which have moderately wide water spaces we believe the precaution to be superfluous. Our incredulity of the beneficial operation of Mr. Johnstone's $\frac{1}{4}$ in. water spaces was meant to be applicable not to a nurseling experiment, but to the average circumstances which occur in practice. We have often seen, even in the course of a single voyage, the flat sides of a furnace puckered and spoiled from the steam lodging in irregularities of the surface; and what must be the effect of such accidents in a boiler the construction of which is such that a protuberance of even $\frac{1}{8}$th of an inch, whether from the formation of a vacuum in the boilers or otherwise, would bring the heating surfaces of the flues into contact? The formation of scale, the bulging of the plates, or even the listing of the ship, might work the destruction of such a boiler; and is it to be supposed that a plan environed by such perils could justify its adoption in practice? Hancock and other steam-coach projectors long ago adopted narrow water space boilers, excusing the eccentricity by the great lightness of such a construction; but though such boilers worked, nobody we believe asserts that they were better than common boilers, or furnish examples for general imitation. Perkins again, long ago, insisted on the importance of establishing distinct channels for the different currents of water, and the plan was tried in many instances, but no appreciable advantage was found to result, and the expedient was therefore relinquished. The censure of neglect will we believe in time also overtake Mr. Johnstone's scheme, and from this fate it cannot be rescued by the prettiness of Polytechnic experiments, or the labours and sacrifices of talent misapplied.]

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*Dimensions of Tubular Boilers.*—The table of dimensions of tubular boilers which you have given in your Treatise on the Steam Engine, is likely to prove of much utility to practical men. I had previously compiled a similar table which I forward to you, and trust that you may be able to give it insertion in the *Artizan.* The horses power are computed according to your rule or table of horses power: the rest of the particulars of the table sufficiently explain themselves, and need not therefore be more particularly described by yours, &c.—R.L.

TABLE OF DIMENSIONS OF TUBULAR BOILERS.

| Power ... ... | 270 H.P. | 288 H.P. | 252 H.P. | 308 H.P. | 293 H.P. | 317 H.P. | 160 H.P. | 82 H.P. | 260 H.P. |
|---|---|---|---|---|---|---|---|---|---|
| Name of Vessel ... | Royal George | Braganza | Dundee | Infernal | Tagus | Royal Consort | The Queen Whitehaven St. Nav. Compy. | Invincible | Phœnix Government Steamer |
| Diameter of cylinder... | 61 in | 62 in. | 58 in | 65 in. | 62 in. | 65 | | [illegible] | |
| Length of stroke ... | 5 ft. | 5ft. 6in. | 5 ft. 6 in. | 5 ft. | 5 ft. 9 in. | 5 ft. 6 in. | | 4 ft. 2 in. | |
| Boilers made by ... | Todd & M'Gregor. | Bury, Curtis and Co. | Hutton & Steel | Miller and Ravenhill. | Miller and Ravenhill. | Todd and M'Gregor | Fawcett and Preston. | Todd and M'Gregor | Penn & Co. |
| How supplied with stm. | Fair | Abundance | Too much | Scarce | Short | Abundance | Not known. | Abundance | Scarce |
| Furnace bar p. H.P. ... | .533 ft | .330 ft | .761 ft. | .535 ft. | .382 ft. | .564 ft. | .367 ft. | .588 ft. | .450.ft. |
| Length of tube, p. H.P | 10.44 ft | 13.96 ft | 14.56 ft. | 10.87 ft. | 9 ft. | 12.48 ft. | 11.277 ft. | 12.68 ft. | 13 ft. |
| Area of tube surface per H.P. ... ... | 11.36 in. | 14,44 in. | 19.5 in. | 9.81 in. | 8.40 in. | 14.13 in. | 11 in. | 11.56 in | 14 in. |
| Heating surface of tube p. H.P. ... ... | 8.20 ft. | 10.93 ft. | 11.383 ft. | 8.25 ft. | 6.35 ft. | 9.762 ft. | 8.65 ft. | 9.12 ft. | 10.2 ft. |
| Area of fire grate per square foot of sectional area of tubes ... | 6.76 | 3.75 | 5.62 | 7.85 | 6.6 | 5.747 | 4.8 | 11.05 | 4.42 |

## Art. XIV.—PAPERS FOR REFERENCE.

### SPECIFICATION OF TUBULAR BOILERS, &c., FOR THE ABERDEEN STEAM NAVIGATION COMPANY'S STEAM SHIP "DUCHESS OF SUTHERLAND."

*Arrangement.*—Two independent tubular boilers fired at both ends, the dimensions and construction of which will be according to the accompanying plans, sections, and specifications.

*Dimensions of Material.*—The iron of bottom, and part of the sides of the boilers to the extent of 9 ft. 6 in. broad, and the whole length. to be 7-16 in. thick; for the ends of the boilers, from the top of the furnace mouths downwards, 7-16 in. thick; for the ash-pans and uptakes of chimnies, 7-16 in. thick; for the sides, ends, steam chest and crown to be $\frac{3}{8}$ in. thick; for the sides, crowns of furnaces, $\frac{3}{8}$, and waterbridges and termination flues, $\frac{3}{8}$ in. thick; the tube plates are to be $\frac{3}{4}$ in. thick, and all the angle iron to be 3 in. by 3 in. and $\frac{3}{8}$ in. thick.

*Quality of Material.*—All the furnaces above the line of the bars to be of the best Lowmoor boiler plate, to be made in three plates (one on each side, and one on top), the underseam of rivets to be below, and in the same direction as, the furnace bars; the waterbridges to be also of the best Lowmoor boiler plate, and to have no cross landings exposed to the action of the fire; the tube plates to be of best Lowmoor boiler plate—the bottom sides, crown and steam chest to be of the best Thornycroft Crown S. iron, the stays in the furnaces to be of best Lowmoor iron, and all other stays to be of best Staffordshire scrap; the angle iron also to be of best Staffordshire iron.

*Rivets and Rivetting.*—All the rivets to be of best Lowmoor rivet iron, 11-16 in. diameter; the bottom, and as far up the sides as the 7-16 in. iron extends, to be double rivetted $2\frac{3}{8}$ in. from centre to centre of rivets, all the single landings to have rivets, also 11-16 of an inch diameter and $2\frac{1}{8}$ in. from centre to centre: where the boilers join, and round the neck of the funnel where the hoops go on, to be countersunk and flush rivetted.

*Stays.*—The shell of the boiler shall be properly stayed with stays $1\frac{1}{4}$ in. square from the crown to the bottom, and from the crown to the top of the smoke boxes, twenty-four in number, to the lengths represented; the stays of the furnaces to be $1\frac{1}{2}$ in. diameter, screwed into the sides of the furnaces with nuts outside and inside of plates; the two boilers to be secured together with four straps of malleable iron, $4\frac{1}{2}$ in. broad by $\frac{3}{4}$ in. thick, and also two hoops to be shrunk on at top where the uptakes join, as shewn in plan.

*Tubes.*—There shall be 524 malleable iron tubes, 5 ft. 9 in. long and 3 in. diameter in both boilers of Russel's patent boiler tube.

*Manner of Fixing Tubes.*—The tubes to be enlarged at the end next furnace fronts, and the corresponding tube plate to be bored 1-16 in. wider, so that the tube may be driven tight into both plates, forming a water-tight joint before they are rivetted; the plates are to be countersunk, and the tubes rivetted into their respective places.

*Manhole Doors.*—To have three manhole doors in each boiler, one to enter on the top of the tubes, one below the tubes, and one to enter on the midship side of the boiler at the termination flue; these doors to be of malleable iron, and their bars, and bolts, and nuts of best malleable iron.

*Mudhole Doors.*—To have four mudhole doors of cast iron, the cross bars, bolts and nuts of best malleable iron.

*Smoke Box Doors.*—To have doors of malleable iron with fender plates, the whole size of smoke box with handles and latches of malleable iron.

*Coal Boxes.*—The coal boxes to be made of sheet iron, 8 lbs. to the square foot, to be fitted completely over the top and down the sides of boilers, so as to cover them entirely, and supported on feet from the same, and likewise with brackets from the ships sides about $3\frac{1}{2}$ ft. apart, the bunker not to be nearer to any part of the boilers than 4 in., a casing of the same thickness of plate to surround the steam chest—the front and after boxes to be also of the same size of plate, to be framed with angle iron, $2\frac{1}{2}$ in. by $2\frac{1}{2}$ in., 5-16 in. thick, the coal boxes to be continued over the after stokehole to the bulk head with a space amidships for entrance.

*Smoke Funnel.*—The smoke funnel to be $40\frac{1}{2}$ ft. long by 4 ft. 4 in. diameter, made of sheet iron, 3-16 in. thick, flush jointed and countersunk rivetted, to be made of plates 9 ft. long, and a top plate $4\frac{1}{2}$ ft. long, with an ornamental hoop on each landing, and one at top; the hoop next top to be provided with eyes to attach the funnel stays to, also a damper at bottom with handle catch and wheel, an air casing to surround the base of funnel, about 6 ft. high with a hood on top water-tight to be same size of plate as funnel.

*Furnace Bars.*—The furnaces to be provided with a complete set of bars, 5 ft. 11 in. long, and doors and fenders of malleable iron, the ash pits also to be provided with doors for regulating the draught.

*Communication Steam Pipe.*—One cast iron communication steam pipe with faucet and gland, to be bolted to the steam chest, with sixteen $\frac{7}{8}$ in. bolts, one-half of it being represented in the drawing.

*Cast Iron Casings.*—Two cast iron casings with flanges, open at top and close at bottom, $1\frac{3}{8}$ in. thick to be bolted to inside of steam chest, with twelve $\frac{7}{8}$ in. bolts each, to be 9 in. by 14 in. inside, and 3 ft. 3 in. long.

*Blow-off Pipe and Cocks.*—One set of blow-off pipes, and cocks (of brass) for each boiler, the pipes of cast iron to be $1\frac{1}{2}$ in. thick, with glands and bolts of malleable iron (as represented in drawing.)

*Safety Valve Chest.*—One safety valve chest of cast iron (same as is presently in use), with two valves 10 in. diameter and seats of brass to be accurately turned and ground steam-tight, with weights of cast iron for a pressure of 10lbs. to the square inch; provision being made for working one of the valves in the engine-room.

*Steam Pipe.*—One malleable iron steam pipe 28 ft. long by 18 in. internal diameter, to be countersunk rivetted (the parties contracting to take this and every other measurement for their own satisfaction.)

*Feed Cocks.*—Two new feed cocks of brass to be turned and finished with glands and bolts of brass; the old feed pipes to be used up as far as they will suit, and the contractors to find new ones where required.

*Gauge Cocks.*—To be provided with sixteen gauge cocks of brass, turned and polished, also four set of gauge glass mounting, also to be furnished.

*Old Appendages.*—As the following appendages will come into use, the estimates to include the expense of connecting them with the new boilers, viz. copper waste steam pipe and pipe for condensed water in safety valves and feed pipes.

*Caulking and Painting.*—The whole and every part of the boilers to be properly caulked inside and outside, and previous to being taken off the contracting parties hands they will require to be subjected to a water pressure of 16 lbs. avoirdupois on the square inch at the bottom of the boiler, in the presence of any party the Aberdeen Steam Navigation Company may appoint.—The boilers, coal-boxes, &c., to receive three coats of the best metallic paint.

It is to be distinctly understood that, whether herein particularly specified or not, the boilers with all their appurtenances are to be complete, so as to ensure their efficient and proper working, capable of propelling the engines at their proper velocity, and the estimate includes the expense of connecting the present mountings to the new boilers.

The whole and every portion of the works before described, and with reference to the drawings, dimensions, and descriptions, marked therein, must be performed in a substantial and workmanlike manner, whether mentioned herein or not, and all parts thereof to the entire satisfaction of the said Aberdeen Steam Navigation Company, or the inspector appointed by them, under whose superintendence, and to whose satisfaction in regard to material and workmanship, the whole shall be carried on and completed.

It will be understood that the company shall have power to make, during the progress of the work, any alterations or additions they may think necessary or beneficial, without altering the terms of the contract; and no alteration shall be allowed to be made unless certified by the company's inspector, and the certificate signed by the chairman of the company at the time; and in the event of any alterations being made, the extra charge or deduction for the same shall be agreed on before such change is made.

The whole of the foregoing work to be completed and rendered in every respect fit for use, by fitting up the same and attaching them to the engines within six months from the date hereof, so as the vessel may be fit for going to sea; and if not completed by the stated time, the contract price shall suffer a deduction at the rate of ten pounds sterling per day for every day after the expiration of the stated time.

The contracting parties to remove the present boilers from the vessel, which, exclusive of carpenter work, must be done at their own expense and risk; the old boilers along with the following appurtenances, viz: two cast iron communication steam pipes, one malleable iron do., safety valves and chest with the inside weights of same, blow off pipes and cocks, feed cocks, gauge cocks, and water glass mounting, manhole and mudhole doors, fire bars and bearers, to belong to the party who contracts for the new boilers.

*Upholding Boilers.*—The contractors to uphold the boilers at their own expense, keeping them in good working order and condition for the period of twelve months from the time of the vessel being put on any passage.

The directors not to be bound to accept the lowest offer unless otherwise satisfactory.

Parties wishing to contract must have their tenders delivered at the company's office, addressed to the directors, on or before the seventeenth day of June next.

Aberdeen Steam Navigation Company's office,
Aberdeen, May 30, 1845.

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### SPECIFICATION OF THE MANNER OF CONSTRUCTING AND ERECTING A TANK, GASHOLDER, AND SUSPENSION FRAME, REQUIRED FOR THE EDINBURGH GASLIGHT COMPANY'S WORKS.

The tank to be made of cast iron plates of best No. 2 pig iron, eighty-four feet diameter, twenty feet deep, inside measure, besides the breadth of bottom flanges. The bottom to be made of seven courses of plates; the centre plate to have four ribs, four inches deep, seven-eighths inch thick; the plates to be made the size as shown on plan No. 1, all to be seven-eighths inch thick: the flanges to be five inches broad on the face and seven-eighths inch thick, and to be joined together with one inch bolts not more than six inches from centre to centre.

The sides of tank to be formed of four heights of circular rings, each eighty-four feet diameter, inside measure; having fifty-six plates in each ring; the first course of plates joined to the bottom to be one and a quarter inches thick; the second course of plates to be one and one-eighth inches thick; the third course of plates to be one inch thick; the fourth or upper course of plates to be seven-eighths of an inch thick. All the plates to have a slip round the bottom flanges a quarter of an inch broad, by one-eighth of an inch thick, leaving a space of a quarter of an inch for jointing. The flanges to be the same thickness throughout as the different plates already described, and all to be five and three-quarter inches broad on the face.

All the flanges throughout to be strengthened by a half-inch fillet in the corners, and a circular bracket of a proportionate strength to the thickness of the plates to be put between each bolt.

The bottom and first course of side plates to be jointed together with one and a quarter inch bolts; the second course of plates to be jointed together, and to the first course of plates with one and one-eighth inch bolts; the third course of plates to be jointed together, and to the second course of plates with one inch bolts; the fourth or upper course of plates to be joined together, and to the third course of plates with seven-eighths of an inch bolts: the distance betwixt all the bolts of the tank not to be more than six inches from centre to centre.

The bolts all to be made of a proportionate strength of the best Lowmoor iron with cut screws, so as to work easily, and to be properly lapped on the head with tarred yarn when put in, and to have a platted lapping on the point with washers upon each of them.

All the joints of the tank to be made or filled up with the best rust mixture, properly hammered into the joints and made perfectly water-tight.

The entrance and exit pipes in tank to be twelve inches calibre, three quarter inches thick: to be cast in two lengths, and to stand one inch above the level of the mouth of the tank; a branch to be cast on one of the plates of the outer course of bottom, twelve inches calibre, three feet six inches from the inside of tank to the centre of the branch, and to be six inches long with a flange round the mouth three and three-quarter inches broad on the face; the flanges of all the pipes to be the same breadth, and made fast to each other with ten three-quarter inch bolts, and jointed with rust mixture.

The pipes to be connected to the outside of tank with a suitable bend, the same strength as the above, nine feet long, the bend to be jointed to the bottom plate with ten three-quarter inch bolts, and jointed with mill-board and white lead; a box to be connected to the other end of the pipe in the same manner, the box to be of one casting with the exception of the lid or cover, which is to be put on with three-quarter inch bolts, five and a half inches from centre to centre, and jointed with rust mixture; this box to be three feet long, two feet wide, and two feet deep, three-quarters of an inch thick; a hole to be cast in one end, twelve inches diameter, as near to the top as the flange of the pipe will allow; another hole of the same size to be cast in the cover, as near to the opposite end as possible, one nine feet length of twelve inch pipe to be made fast to the cover as the other pipes already described. All the bolts connected with this pipe to have proper hemp lappings on head, and points with washers on each of them.

It must be understood that the tank and gas-holder are to be erected on the company's works at Tanfield, and that the tank is to be sunk level with the ground. The ground to be excavated at the expense of the Edinburgh Gaslight Company, and the tank to be put in by the contractor level with the ground, and the bottom to be properly levelled on a bed of sand; the ground around the tank to be afterwards refilled, and properly beat in at the expense of the Gaslight Company.

The frame for suspending the gas-holder to be formed with three strong standards, as represented in the drawings; the standards to be made of cast iron, the sole plate to be eight feet one way, by seven feet six inches the other, circled on the one edge to fit the tank, and to be one and a half inches thick, with one opening in the centre four feet eight inches square, and circled in the corners with a seven inch traner, each of these plates to be made fast to the upper flange of the tank with five one and a quarter inch screw bolts; the other three sides to be made fast with eleven one and a quarter inch bat bolts, nine inches long, to be sunk into the stone work six and a half inches, and run in with lead. The pier of mason work to be erected for fixing the same, is to be done at the expense of the Gaslight Company.

The corner stiles of the standards to be thirty feet high up to the moulding for fixing them together at the top, and to go eight inches up within the moulding, and to be made fast to each other with two one inch bolts in each side; the stiles to be twelve inches broad at bottom, with a flange projecting six inches all round, and circled in the inner corner to fit the sole plate, and to be strengthened round the corners with a one and a quarter inch hollow fillet, and to be made fast to the sole plate with seven one and an eighth inch square necked bolts in each. The stile to be nine inches at top each way, and to be strengthened with three one and a half inch beads, and to stand one inch and a quarter up off the plate, the inner corner to be strengthened with a one and a half inch hollow fillet: a recess to be formed in the stiles fourteen inches deep, six and a half inches wide for receiving the wooden beams, as shown in the section. The stiles being nine and a half inches broad at this part, allows the metal all round the recess to be one and a half inches thick. The two recesses where the three-fold pulley is to work, must be twenty-two inches deep, so as to allow the plummer block to go into its proper place; the standards to be bound together on each side with six and a half heights of crosses, the first cross at the bottom to be eight inches broad, and to diminish gradually to five inches at the top, all o be one and a quarter inch thick, and to be strengthened on the outside with a feather one and three-quarter inches deep, one and a quarter inches thick, and to be further strengthened on the inside with a feather one and three quarter inches deep at the first cross, at bottom, and to diminish to three quarters of an inch deep at top, all one and a quarter inches thick; these crosses to be properly fitted in between the stiles; the first three heights of crosses to be made fast at the ends with two one inch bolts in each, the other three and a half inch crosses to be made fast at the ends with two three quarter inch bolts in each; all the bolts of these crosses to have countersunk heads, and made perfectly flush on the outside. The frame with the projecting moulding round the top to be of one casting nine inches deep, and to project seven inches, and to be cast hollow, and as nearly as possible one inch thick; two openings to be made on the inside of this frame so as to allow the bolts to be got through the top of the stiles, and screwed to each other from the inside; a slip to be cast round the inside of this frame, and to stand three quarters of an inch up off the plate, so as to keep the cope in its proper place. The cope for finishing the top of the standards to be three feet six inches square, nine inches deep; two of these to be half an inch thick, the other, where the balance weight is suspended, to be three quarters of an inch thick, with a cross bar in the centre two inches thick, and nine inches deep at the centre, and to have a hole two inches square to receive the pin of the shears for the pulley of the crane.

A circular bracket to be placed under each of the beams, similar to that shown on the cross section, to be four feet nine inches long each way, to where the scroll commences; the plate under the beam and on the the front of the stile to be six inches broad, one a half inches thick; the circular stay to be seven inches broad, one a half inches thick, and to be strengthened on each side with a feather two inches deep, one and a half inches thick, and to be neatly formed off at the scrolls, and to be made fast to the stile with five one inch bolts, and to the wood beams with three three-quarters inch bolts.

The centre to which the beams are attached to be of cast iron, and of one casting with the exception of the covers, to be four feet diameter, and twelve inches deep inside; the recess for the beams to run as near the centre as possible and that to suit the ascent of the beams; this casting not to be more than one inch thick throughout and to have an eye on the centre three and a half inches square; this eye is to receive a malleable iron spindle for the purpose of putting in horizontal pulleys; the end of this spindle to be truly turned sixteen inches long for the journal of pulleys. The cover of the centre to be five feet diameter, three quarters of an inch thick, with a moulding round the under edge as shown, leaving the recesses out of it for the beams; the centre and top plates to be made fast to each other with two seven-eighths inch bolts in the end of each beam.

The six beams to be of the very best Memel timber, perfectly free from sapwood, and as free as possible from notches; the beams at the standards to be fourteen inches deep, and twelve inches deep at the centre, and to be six and a half inches thick; these beams are to be properly dressed and fitted into the standards and centre, and properly wedged into the former in a most substantial and tradesmanlike manner.

Each set of these beams to be bound together with three cross binders; to be four and a half inches diameter, one inch thick; the cross heads to be sunk into the beams and made fast to them with two three quarter inch square bolts in each end; these binders to have a round centre where the tension rod goes through, so as to make up for the reduction of the strength of the hole for the tension rod.

A tension rod of one and a quarter inches round iron to pass through the centre of these binders, and to be screwed for four inches on each end, and to be furnished with suitable washers and nuts.

On the centre, to which the beams are screwed, will be fixed a cast-iron pillar, to hang perpendicularly down four feet four inches, for the purpose of supporting the centre of the beams; six tension rods, of one-and-a-half inch round iron to be fixed to this pillar, as shewn on the section, the rods to have eyes at the centre, and two plates, sixteen inches diameter, three-quarters of an inch thick, with a one-and-a-half inch hole in the centre, to go on a pin, in the lower end of the pillar; this pin to be of one-and-a-half inch diameter, to be made fast into the pillar with a key; the vase under the plates also to be made fast with a key; six one-and-a-quarter inch holes to be made in the plates, for the purpose of bolting the tension-rods and plates together, with round bolts neatly fitted into the holes, the other of these rods to have a connecting joint, of a proportionate strength; near to the circular bracket, under the beam, a square bar, of one-and-a-half inch iron, to be let flush into the centre of the beams, and to go through the standards, and to be furnished with a one-and-three-quarters of an inch screw, four inches long, and to have six pinned nuts: a recess, one inch deep, to be made in the end of the circular brackets, so as to keep the rods as near the straight as possible.

The two single pulleys to be four feet four inches diameter, four-and-three-quarters of an inch wide, to have a round centre with six arms, of a proportionate strength, with eight pinned malleable iron spindles, four inches square; the pulleys to be truly hung, with eight malleable iron keys; the journals to be truly turned to three inches diameter, and neatly fitted into cast-iron plummer blocks, and to be mounted with brass; a plate of cast-iron, two feet four inches long, six-and-a-half inches broad, one-and-a-half inch thick, with two brackets, for the purpose of keying the plummer blocks in their proper place,—to be placed on the wooden beams under each of the plummer blocks, and made fast to the beams with four seven-eighths inch bolts in each; two of which to be counter-sunk, so as not to interfere with the site of the plummer block. The site of the plummer block to be sixteen inches long, four-and-a-half inches broad, one-and-a-quarter of an inch thick, with an oblong hole in each end, two-and-three-quarters inches long, one-and-three-eighths of an inch wide, and to be fixed down to the plate with two one-and-a-quarter inch bolts; the other three-fold pulleys to be fitted up in the same manner as the above. The two horizontal pulleys to be two feet eight inches diameter, four-and-a-half inches wide, with six arms, of a proportionate strength, and the eyes to be truly bored out to three-and-a-half inches diameter, and to be turned on the face, so as to work easy on the spindle already described; a wood vase to be placed in the centre, as shewn in the drawing.

The suspension chains to be made of seven-eighths of an inch round malleable iron, and the links to be made as short as possible, and to have muzzle links made fast to the chain, to join the ruff and eye connected to the top of the gas holder; this link to be made as shewn in the section, with a screw twelve inches long.

On the other ends of the chains there are to be connected two rods, of one-and-three-quarters inches round malleable iron, eight feet long; these rods to have eyes formed at the top, to receive a one-and-a-half inch connecting pin; three links, with suitable eyes, for the above pin, to be welded to the ends of the chains; the other ends of the rods to be screwed and to have square nuts for the balance weights to rest upon.

The upper balance weight to be five tons; the weights to be two feet six inches diameter, one-and-a-quarter of an inch thick, rounded on the edge, forming beads, and cast in two halves,—one plate on the bottom, to be in one piece, three-and-three-quarters inches thick; one oblong hole to be cast in the centre of this weight, ten inches by four inches, and rounded at the ends; this hole is to allow the crane chain to work through the centre of this weight, for the purpose of raising the under counter-balance weight when the gas holder is down; other two one-and-three-quarters inch holes to be cast in this weight, one at each side of the oblong hole, four-and-a-half inches from the centre, or nine inches from centre to centre; a square recess to be cast in the under weight to receive the nuts on the ends of the rods. Two holding-snugs to be cast on each half of the weights, to receive each other at right angles, for the purpose of steadying the weights.

The under counter-balance weight also to be five tons, making in all ten tons of balance weight, and made in the same manner as that already described, but only to have one two-and-a-quarter inch hole in the centre. The rod for the weight to be of two-and-a-quarter inches round iron, thirteen feet long, and to be furnished with a screw and nut at the lower end, the upper end to be connected to the crane chain with a strong eye; another eye to be formed on this rod, six inches further down; a link to be placed on each side of the centre chain where the three chains are connected, and made fast to the rods of the upper weight: other two strong links to be connected to the above, with two links of the common chain betwixt them; these links to embrace the eye on the under rod when raised up with the crane, and to be connected to it with a round one-and-three-eighths of an inch bolt screwed in with a nut. A full sized sketch of this connection will be furnished to the contractor.

The crane for raising the counter-balance weight to be formed with two wheels, four feet diameter, and to have six arms; the two pinions to be six iuches diameter; the barrel also to be six inches diameter, to be furnished with two handles, to have a throw of eighteen inches; the stiles where the journals are to work must be pieced up to the plumb on the out and inside, so as to enable proper recesses to be got for the brasses; these brasses to have a collar on each side, and to be neatly fitted in and truly bored out for the journals, and made fast to the stiles with cast-iron covers.

The pulleys for the chain working over to be fifteen inches diameter, and four-and-a-half inches wide, and fixed up to the cover of the standard with a pair of strong malleable iron shears, and made fast on the top with a nut; the hole for this bolt to be made oblong, so as to allow the pulley to shift backwards or forwards, as may be required.

The chain to be made of three-quarters of an inch round malleable iron, and the links made as short as possible; a strong catch to be fixed to the stile and to act into the teeth of the wheel on the end of the barrel spindle.

The aforesaid crane all to be of very best workmanship, and of a proportionate strength, and capable of raising ten tons with ease.

The gas-holder to be eighty-three feet diameter and twenty feet deep, and to be made of Bradley's best rolled sheet-iron; the thickness to be of No. 15 wire gauge, and of two lbs. six ozs. to every superficial foot; the top or roof to be formed of rows or courses of plate, cut so as to make them radiate from the centre; the end points of which plates are to form circles. The roof to have a rise of two feet from the edge to the centre.

The sides to be formed of plates four feet long and two feet broad.

The whole of the sheet-iron to be well flattened, and the sides of the gas-holder to be made completely circular. All the jointings of the sheet-iron are to overlap each other one-and-a-quarter of an inch, and to be rivetted together with one quarter such rivets, made of the best horse-nail iron, thirteen rivets to every foot.

A ring, of three-and-a-half inches angle iron, to go round the upper corner of the gas-holder, to which ring the top and side plates are to be rivetted in the manner above described; two rings, of three-inch angle iron, to go round the centre and mouth or under edge of the gas-holder, to which rings the side plates are to be made fast with two-eighths of an inch bolts, twelve inches apart, with neatly rounded-off heads on the outside.

The ends of the angle iron of all the rings are to be jointed to each other, with clasps of angle iron laid inside, and each clasp made fast with eight rivets.

The centre of the top or roof is to have a corner plate, three feet diameter, three-quarters of an inch thick, and to be thinned down at the edge by being turned, with holes round the same to rivet on the plates of the roof, the same as the other jointings.

The whole of the heads of the rivets in every part of the gas-holder to be neatly rounded over.

Thirty bars or joists are to radiate from the crown plate to the angle iron ring, these to be three-and-quarter inches broad, five-eighths of an inch thick, with the exception of the three joists to which the suspension chains are attached, which must be four inches broad and three-quarters of an inch thick; the ends of these at the angle iron ring to have one-and-a-half inch round eyes, and all the other ends to be furnished with one inch eyes to bolt to the angle iron ring and crown plate, the bolt-holes in the crown plate to be four-and-a-half inches from its edge.

In bolting the joists to the crown plate a ring of iron, three-and-a-half inches broad, by five-eighths of an inch thick, is to be placed over the ends and under edges of the joists, with bolt-holes corresponding with those of the crown plates, for the purpose of steadying the joists; the other ends of the joists are to be checked down on their upper edges where they are bolted to the angle iron, so that they may be all flat on the top with the angle iron ring, and all to be put together with one inch bolts.

Each of the above joists to be furnished with a tension rod, of seven-eighths of an inch round iron, and made double at the ends, to embrace the thickness of the joists, and to be made fast to them with five-eighths of an inch bolts, four inches from the ends; the other ends of these rods to have eyes to go on the upright stays; the upright stays to be two feet three inches long, and also to be made double to embrace the thickness of the joists, and to be made fast to them with five-eighths of an in. bolts, the under ends to be furnished with a screw, four inches long, and to have two nuts, one to be above, and the other to be below the rods, and screwed tight together.

Between each space formed by the above joists there will he another set of joists as shewn on the section, and to be three inches broad, half an inch thick, and to be made fast to the angle iron ring the same as those already described, the other ends to be furnished with a five-eighths of an inch pin, screwed on the end and made fast to the sixth transverse bar of angle iron.

Each of the above joists to be formed with a tension rod of three-quarters of an inch round iron, with an upright stay in the centre, and otherways made fast, as those described for the other joists.

Each space between the joists or radiating bar to be transversely divided into twelve spaces, by eleven bars of angle iron, one-and-three-quarters of an inch broad; the centre bar, where the intermediate joists are fixed, to be two-and-a-quarter inches broad, and to pass from one to another, with their ends kneed to suit the angle of the joists, and made fast thereto, with one five-eighths inch bolt in each end; the angle iron to be kept level with the joists on the top. The sheet-iron of the top all to be made fast to these bars with three-eighths of an inch bolts, fourteen inches apart; the heads to be neatly rounded off on the outside.

A round bar of iron, two-and-a-half inches diameter, at the ends, to swell in the middle to three-and-a-quarter inches, and to be fourteen feet nine inches long, and is to hang perpendicularly down from the crown plate; the upper end of this bar is to be reduced down to one-and-three-quarters of an inch diameter, and screwed, which is to go through the crown plate and to have a large ruff under the plate, and fast above with a six pinned nut. There is to be fixed at the lower end of this rod a cast-iron plate, twenty-two inches diameter, one-and-a-half inch thick, to have an edging round it six inches broad, by one-and-a-quarter inch thick, and to be hooped with malleable iron, six inches broad, three-quarters of an inch thick. Six holes to be made in the edge of this plate to admit the ends of the tension rods; this plate to be fixed to the rod in the same manner as the above, but only to be reduced at the end to two-and-a-quarter inches diameter.

Three round rods, of one-and-three-quarter inches iron, to go from the plate on the bottom of the perpendicular bar up to the points of suspension, and made fast to the joists as near the end as possible. The ends to be made double, so as to embrace the thickness of the joists, and secured to them with a one-and-a-quarter inch bolt; the other end of the rods at the plate to have screws, five inches long, and to be two inches diameter, with nuts of a proportionate strength, and to be supported in the centre with a three-quarters inch round rod, to be made fast to the joists above with a five-eighths inch bolt, and to be made double at the other end, and made fast with a key.

Another rod, of one-and-a-quarter of an inch round iron, to be placed between each of the aforesaid rods, and fitted up in the same manner; to be made fast to the joists with a seven-eighths inch bolt, and to be furnished with a screw at the other end, of a proportionate strength to the rod; these rods may either be in one or two lengths, as the contractor may choose.

At each point of suspension where the large tension rod is connected to the joist, will be fixed two rods, of one-and-a-quarter inch round iron, to have eyes to go on to the bolt that fixes the large tension rod to the joist, and to go down to the angle iron ring on the centre of the gas-holder as shewn, and made fast to it with two three-quarters inch bolts in each.

The gas-holder to be suspended from three points at equal distances, and one five-eighth inches from the edge at top; for this purpose three one-and-a-half inches round bolts are to be furnished with a ruff and an eye to connect to the muzzle links on the ends of the suspension chains; these bolts are to go through the eyes of the same joists to which the tension rods are attached; the bolts in the ends of the joists where the other tension rods are connected, to be furnished with suitable eyes on the outside for connecting the tackle for raising the gas-holder when making.

The top of the gas-holder to be furnished with two manhole doors of a suitable size, of an elliptic shape, and placed at opposite sides; a frame of iron three-eighths of an inch thick, by two inches broad, is to go round the opening on inside of the roof; another frame similar to the above, but only a quarter inch thick, is to be rivetted to the place which is to form the door, and to be screwed down with eighteen three-eighths of an inch square headed bolts.

Twelve cast-iron guide rollers, truly turned, with seven-eighth inch malleable iron spindles, five inches diameter, two inches thick, to be equally divided round the gas-holder, and fixed to the under angle iron ring with two kneed brackets of malleable iron, nine inches long, two-and-a-half inches broad, half inch thick, and to be made fast to the ring with two five-eighth inch bolts in each, the rollers to run half an inch clear of the gas-holders.

In raising the gas-holder during its making it must be understood that the contractor must provide himself with three spars, and to be fixed up between the points of suspension; to which tackles and cranes are to be attached for the purpose of assisting the balance weight to raise the gas-holder.

The whole of the iron used for the framing of the gas-holder to be of the best quality of Lowmoor iron, and to be free from rust, and to receive a coat of Linseed oil before leaving the contractor's premises; and when the gas-holder and suspension frame are finished, they are to receive two coats out and inside of the best light lead-coloured oil paint made up with white lead, and to be made perfectly gas-tight.

The whole work in the foregoing specification, or as represented in the several drawings, to be executed in the most substantial and tradesmanlike manner, and to the entire satisfaction of the Directors of the Company, or their Manager, or of their Engineer, or of any other competent person they may appoint; and it must be expressly understood that every expense attending the entire completion of the work, including all carriages and scaffolding, and whatever omissions may have occurred in the drawings or specifications, these articles must nevertheless be completely finished like corresponding portions of the work, or other work of a similar nature.

The contractor must run all risk in putting the same work into operation.

The contractor will produce sufficient security for the due fulfilment of the work, and become bound to complete the tank, suspension frame, and appurtenances, by the 15th of July of the present year, and the gas-holder by 1st of October of the present year, under the penalty of five pounds sterling for every day afterwards.

Estimates to be given for the tank, suspension-frame, aud all appurtenances in one slump sum, and the gas-holder for another slump sum, inclusive of all the work connected with each as before specified.

The tenders to be addressed to Mr. Watson, manager for the company, sealed and marked on the back, "Tender for Gas-holder and Tank," or for these separately, as the case may be, and delivered at this office on or before Thursday, the 9th of March next.

Edinburgh Gaslight Company's Office, Waterloo Place.

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REPORT UPON THE LOSS OF THE "GREAT LIVERPOOL" STEAMER.

The Committee appointed by the Minutes of the Board of the 31st of March, 1846, to investigate the circumstances connected with the loss of the *Great Liverpool* steam-ship, on the morning of the 24th February, at four o'clock, about ten miles from Cape Finisterre, report:—That—Having read the letter of the late Commander of the *Great Liverpool*, dated Vice-Consulate Office, district of Corcubion, 24th February, 1846, announcing the loss of that vessel at four o'clock in the morning of that day, by her striking on a rock or shoal; having closely inspected the log of that ship for forty-eight hours previous, as well as her logs for twenty-one previous homeward-bound voyages—the night-order book of the late commander, containing the orders given on the night of the 23rd February at eight o'clock, as well as the day's works or reckonings of the officers of the ship, as sent in on the previous noon; having closely examined the following witnesses, who were on board the *Great Liverpool* when she was wrecked, viz., Mr. George Hamilton, chief officer, Mr. George Miall, third ditto, Mr. Neil Cook, second ditto, Mr. William Bencraft, fourth ditto, Mr. Edward Lane, purser, Richard Williams, seaman (man at the wheel), James Beale, carpenter, Mr. Samuel Wright, first engineer, as well as Captain John Bowen of the merchant service, (a passenger on board, and who has been a commander in the coasting trade upwards of four years, and twelve years in the merchant service in India):—That gentleman expressed himself to the Committee to the following effect: That he felt perfectly satisfied with the truthfulness of the compasses; that the vessel was steered very correctly; that, having worked the ship's reckoning for *that day* as was his usual practice on the voyage, he felt satisfied the course steered, N.N.E. and N.N.E. ½ E., ought to have taken the vessel nine to twelve miles to the westward of Cape Finisterre; that he was of opinion the vessel was carried so far to the eastward by reason of some unaccountable indraft, which he afterwards supposed to be occasioned by a succession of easterly gales, which had prevailed in the Atlantic for some days previous to and after the wreck of the *Great Liverpool*; that he was very much pleased and gratified with the good order and discipline which prevailed on board the *Great Liverpool*; that Captain M'Leod was always most attentive to his duties, as were also the several officers of the ship, and the orders were given and carried out with a degree of quietness that struck him forcibly; that he never observed the duties on board a ship carried out with more efficient regularity.

On the examination of Captain C. F. Burney, of the Peninsular and Oriental Company's steam-ship *Pacha*, and Mr. James Carter, the chief officer of that vessel, they stated, That, after leaving the Rock of Lisbon on her last homeward voyage on the afternoon of the 2nd March, 1846, they experienced an unusual inset, the vessel being drawn towards the land, and that the course was consequently altered two points to the westward of the course then steering, which circumstance was noted in the log at the time; and that, on the 4th March, when the loss of the *Great Liverpool* was first heard of on board the *Pacha*, Captain Burney was of opinion that it must have been occasioned by the extraordinary and unusual inset which had prevailed on the coast for several days.

Having examined Captain John Soy, of the Peninsular and Oriental Company's steam-ship *Oriental*, he stated as follows:—That the *Oriental* passed Cape Finisterre, on her last outward voyage on the 25th February, at six p.m., (the day after the *Great Liverpool* went on shore) at a distance of from eighteen to twenty-two miles to the westword of it; that he found a remarkably strong inset, so that instead of making the Burlings ten miles on the port bow, as he expected, he made them on the starboard bow, showing a difference in the position in which the vessel ought to have been, according to the course steered, of from fifteen to twenty miles in a run of 210; that he had experienced an inset before, but never to such an extraordinary degree as on the occasion alluded to.

On inspection of the abstract of the log of the Royal Mail Steam Packet Company's steam-ship *Tweed*, Captain George Parsons, on her last outward voyage from Southampton to Madeira, (which ship departed from Southampton on the 17th February, 1846, at three p.m.,) it appears that on the 23rd of the same month it blew a "perfect hurricane" from the S.W. We find that these westerly gales had lasted for upwards of nine days with great severity, and it has been remarked that inset towards the shore is always more apparent during the prevalence of such gales, although the degree and direction of the wind experienced on board the *Great Liverpool* on the coast of Spain and Portugal (being S.S.E. to S. by W. by compass) was not such as to cause any apprehension of inset, in the mind of the late Captain M'Leod, who had made his course true from Cape St. Vincent to the Rock of Lisbon, and thence to the Burlings, from whence he shaped his course to clear Cape Finisterre.

The Committee examined a copy of the chart by which the *Great Liverpool* was navigated (the original having been lost with the vessel). They find, from the evidence, that the compasses were in good order, and true, and that the vessel was correctly steered. They further find that the course steered on this last voyage, was the same as that which had been steered by that vessel with safety on twenty-one previous homeward passages, and that Captain M'Leod had himself been stationed on the forecastle, looking out for two hours previous to the accident, where he continued until the ship struck.

The Committee deem it due to the character of the late Commander of the *Great Liverpool*, to state that the utmost vigilance and care for the safety of the vessel and those on board committed to his charge have been uniformly manifested by that lamented officer; and the Committee, after mature deliberation on the whole evidence adduced, are unanimously of opinion, that the loss of the *Great Liverpool* was occasioned by a very unusual inset from the ocean, which had never been met with in any of her former voyages, or in the experience of the several commanders and officers whose evidence has been taken.

Signed) SAMUEL THORNTON, CAPT., R.N.
RICHARD BOURNE, COMMANDER, R.N.
April 7th, 1846. ALEXANDER NAIRNE, CAPT., H.E.I.C.S.

## Art. XV.—THINGS OF THE DAY.

### FINE ARTS.

*The Boodroom Marbles.*—A paper on the subject of the Boodroom marbles, to which we referred at p. 83, was read by Mr. Hamilton at a meeting of the Royal Society of Literature. He stated that at least twelve out of the fourteen fragments which are now on their way to this country, were seen by Messrs. Dawkins and Wood, on their way from Palmyra in 1749 or 1750, and were also seen, drawn, and engraved in 1751 or 1752 by Richard Dalton, one of a party of English travellers who were then engaged with Lord Charlemont in exploring the coasts and islands of the Archipelago. From these drawings which were produced, Mr. Hamilton concluded that the marbles from Halicarnassus are not remains of Archaic art, or similar in character to the Egina statues, but will probably be found to partake more of the florid style, affected flow of drapery, and refined minuteness of execution, which characterized Greek art in the age of Alexander, one hundred years of rapid declension later than the era of the sculptures of the Parthenon. Mr. Hamilton denied that there was any just ground for doubting that these marbles are part of the sculptured decorations of the celebrated tomb of Mausolus, king of Caria, whose death occurred in the fourth year of the 106th Olympiad, two years after the birth of Alexander. On account of the magnificence of this sepulchral monument, it was reckoned among the seven wonders of the world. It is mentioned by many of the ancient writers, but Pliny the elder alone gives a detailed account of it. Of the manner in which this monument was decorated it is only said that four of the most eminent sculptors of the time—Scopas, Leochares, Bruxis, and Timotheus,—were employed by Artemesia, the disconsolate wife and sister of the deceased monarch. Pliny does not state on what part of the building their works were placed; he only says that they each took one side. But from what is known of the practice of the ancients in structures of the dimensions of the Mausoleum, it cannot be doubted that they were affixed to the frieze of the building, between the architrave and cornice.

*Wilton new Church.*—The new church at Wilton contains some ancient mosaic work of great interest in excellent preservation. It originally formed a shrine in the church of Santa Maria Maggiore, at Rome, for the martyrs Simplicius and Faustina; it was the work of Pietro Cavallini, about the year 1256, and was brought to this country in the last century by Sir William Hamilton. Horace Walpole built a chapel to receive it at Strawberry Hill, where it remained until that collection was dispersed a few years ago; it was then purchased by the Right Hon. Sydney Herbert for his new church at Wilton. In Westminster Abbey are works by the same artist, though in a sadly mutilated state, viz., the shrine of Edward the Confessor, finished under Henry III., according to the inscription in 1270—and in the tomb of Henry III. himself who died in 1272, erected by the assistance of Cavallini, by his son Edward I.

*Royal Academy.*—The following subjects have been given out for prizes to be awarded on the 10th of December next, the anniversary of the foundation of the Royal Academy:—A silver medal for the most accurately-finished drawing of "St. Peter's, Cornhill," the plan, elevation, and section to be done from actual measurement. A silver medal for the best medal die, to be cut in steel, from the head of the Giustiniani Apollo in the Royal Academy; the size to be not less than 1¼-inch in diameter. Silver medals for each of the best drawings and models in the antique and life schools, and two silver medals for the best copies made in the school of painting between the time of its opening after the exhibition and the first of November next.

*Origin of the Volute.*—At a late meeting of the Decorative Art Society, Mr. E. Cooper exhibited a process for producing a volute by means of a natural form. He had selected a shell, the *Buccinum spiratum*, or *Syracuse whelk*, and affixed it to a board; a string with crayons attached was then wound along the spiral hollow of the shell, and this, in the course of its convolutions, delineated what he assumed to be the Greek volute. He compared the result satisfactorily, with engravings by Nicholson, from the Ionic capitals to the Temple on the Illissus, and the Temple of Bacchus at Teos, and he also had detected an exact correspondence in size in Inwood's Erechtheion, plate 21, from the Temple of Victory on the Acropolis. Mr. Cooper then explained that, in an examination of an Ionic capital in the British Museum, he observed that the eye had been fitted with a stone *similar* to the other parts; and, further that, in another instance the eye had been lost out. The orifice thus exposed, he conjectured, had been necessarily made to receive an instrument for guiding the tools used in working mouldings on the face of the volute. Its diameter agreed very nearly with that of the lower part of his shell, and he presumed that a modified cast in metal from the shell would supply an instrument suited to such a purpose, and which at any rate offered an inexpensive and ready mode of striking scrolls for hand-rails &c. Mr. Tapling tested the volute described by Mr. Cooper by a notation of eight radial intersections, and he contended that the scale of expansion was different from that of the Greek volute. His remarks were afterwards sustained by a comparative experiment upon a rubbing which Mr. Cooper had in his possession. It was also said, that the engravings referred to by Mr. Cooper were incorrect.

*Summary.*—A discovery has been made, by the Messrs. Reeves, of Cheapside, of a method of preparing water-colours, by which the evils attendant on the use of gum are said to be obviated, and an accession of power for the production of brilliancy, transparency, and depth. attained, which brings the painter in that material more nearly to the competing level of the artist who works in oils. The medium substituted is virgin wax.—The *Moniteur des Arts* publishes a list of all the towns in France which possess Museums, Art Societies, and have frequent Exhibitions of Painting and Sculpture. The number, which is sixty-two, testifies to an extensive diffusion of taste throughout the nation.—A tablet, subscribed for by the surviving and friends of the deceased officers of the ill-fated steam sloop, the *Eclair*, has been erected in the chapel of Portsmouth dockyard, to the memory of Mr. Estcourt, its late commander.—The French journals speak of the inauguration of the chapel and tomb of Queen Hortense in the Church of Rueil, beside those of her Empress-mother Josephine.—The owners of St. John's-gate have relinquished the idea of compoing it, and have determined to re-case it with stone where defective. The ornamental portions are to be restored, under the direction of Mr. W. P. Griffith, architect.—M. Blouet, the architect to whom Paris is indebted for the works which completed that long unfinished monument, the Triumphal Arch of the Etoile, has been elected to succeed M. Baltard as professor at the School of the Fine Arts in that capital.—Sir Robert Peel has informed the House of Commons that it was his intention to include the name of Sir J. M'Caskill in any form of monumental commemoration which he might ask the House to sanction in the case of Sir Robert Sale; and gave a hint, in answer to some further interrogatories, that he had a more extensive appeal to Art in his contemplation for the honour of the chiefs who have fallen in our recent victories.—Switzerland is about to follow the example of trade exposition becoming so general in Europe; an exhibition of the products of Helvetic industry being announced to take place at Zurich, in August next.—Mr. Hastie, M.P., has contributed the sum of 100*l.* towards the establishment of a school of design in Paisley.—In the park of Malmaison, in France, recently purchased, with its château, by Queen Christina, a Gothic chapel has been erected, under the direction of M. Suréda, the architect, in the style of the Sainte-Chapelle, at the Palais de Justice. The walls are to be covered with mural paintings, in the fashion of the 13th century; and M. Henri de Gerente has just finished one of five windows which are to enrich the building, representing St. Augustin, the patron saint of the Duke de Rianzares. The other subjects will be, St. Christina, the patron of the Queen-Mother; the Holy Virgin; Isabella of Hungary, the patron saint of the Queen of Spain; and St. Louis, the patron of the Infanta Louise.—The ancient temple of the Knights of Malta, at Lanon, a very curious monument, in an architectural point of view, has been restored under the direction of government, and M. Duban and his assistants are making great progress with the works of restoration at the Château of Blois, whose rich old sculptural details are coming out, it is said, with effect.—Two bronze horses, of colossal dimensions, are casting in St. Petersburgh, for the embellishment of the city of Naples.—The French minister at Athens, M. Piscatory, has obtained from the Greek government permission to restore, at his own cost, and by means of the French architects who are pensioners of the School of Rome, a portion of the Temple of Erectheus.—The trial arising out of the charge brought against M. Piscatory, by the *Siècle* and *Minerve*, at Athens, of having removed some marbles from the Temple of Diana at Paros, has been exciting great interest in that capital; and has ended in the condemnation of the two editors.—Not one drawing was received this year by the Royal Academy from the architects who had gained gold medals, in competition for the travelling studentship; consequently the privilege falls to the lot of a painter.—The Royal Academy of Stockholm, in acknowledgment of the many benefits conferred on the arts and artists of Sweden by the late king, Charles John, has unanimously determined that, to perpetuate their memory, a new pediment shall be placed on the principal façade of the palace of the Fine Arts, which shall exhibit the colossal statue of the king, surrounded by allegorical figures recalling the progress made by the liberal arts during his reign.—The following sculptures from Greece have lately been placed in the Louvre:—A votive basso-relievo, representing Theseus, as protecting hero of Attica; a fragment of a frieze on which is represented a scene of the war of the Amazons; a votive basso-relievo from the Island of Crete; and Jupiter with Europa. Twelve marble fragments, with inscriptions from Mylasa in Caria, contain some decrees issued by Mausolus, king of Caria; and belong, therefore, to the fourth century, before the Christian era.—Accounts from Paris state, that a statue representing Bathilde has been ordered of M. Thérasse, for the Garden of the Luxembourg; and that eighteen statues, of celebrated women, destined for the same promenade, have been distributed as commissions amongst the sculptors. The following are some of the subjects:—Sainte Geneviève, Clotilde, Jeanne d'Albret, Blanche of Castille, Valentine of Milan, Jeanne Hachette, Marie de Médicis, Marguerite of Provence, Mary Stuart, Anne of Beaujen, Anne of Brittany, Clémence Isaure, and Marguerite de Valois.—At Constantinople, the sultan has just ordered the establishment of museums of arts and sciences to be open to the public gratuitously. The library of the seraglio also, which has been hitherto jealously guarded against all intrusion, is now open for public use. These measures are owing to the intervention of Reshid Pasha.

CONSTRUCTION.

*Dangers of Steam-Heating Apparatus.*—An alarming accident lately occurred at Exton Church. Just as the congregation had assembled for divine service in the morning, a loud hissing was heard in the chancel, which proceeded from one of the pipes by which the church is heated; the noise gradually became louder, and terminated in an explosion, the steam bursting forth with great force, and the dense atmospherc rendering it impossible to ascertain the extent of danger in which the congregation was placed. The screams of the women added to the confusion, and a simultaneous rush having been made to the different doors in order to escape, numbers were thrown down and trodden upon. Those who were fortunate enough to reach the churchyard were in a fainting state, requiring assistance, which they could not obtain, and those inside were crying loudly for help. Fortunately no lives were lost, and the injuries received were not of any great magnitude. Great fears were entertained for the children of the female Sunday school, a portion of whom sat in the chancel, and who, at the time of the explosion were enveloped in smoke and steam. But after the church became partially cleared of the steam they were discovered huddled together in a corner against the altar, a few of them only being slightly injured. The accident is statcd to have had its origin in an accumulation of foul air in the expansion pipe, but this is an impossible hypothesis. The truth we suppose is that the cap of the expansion pipe was blown off, and we presume that Perkin's heating apparatus was the one made use of. This contrivance is one that is attended with considerable danger: the temperature of the pipes is so high that they will set fire to combustible substances, and the pressure within the pipes is also very great, so that if they burst or become deranged, as in the present instance, an explosion takes place, which, though it is not likely to blow up the building, may scald and greatly alarm the persons present at the time. If Perkin's apparatus be used at all, it should be situated in a vault or out-house, and the hot air should be led into the building by suitable tubes.

*Triumphal Arches.*—At a late meeting of the Institute of British Architects, a paper was read by the Rev. Richard Burgess, on "The Ancient Triumphal Arches." The paper commenced by explaining the purposes for which those monuments were erected; that they were properly divided into two classes, arches of triumph, and honorary arches. The former were placed nowhere but across triumphal roads, like the Via Appia, Via Flaminia, and other great approaches: the Via Sacra, by which the procession moved to the Capitol, was distinguished by several. The honorary arches were placed where the acts they commemorated had taken place, as the Arch of Trajan at Ancona, where that Emperor had built a port; the Arch of Augustus at Susa, at the foot of Mount Cenis, where Augustus passed in journeying to or from the transalpine provinces. Mr. Burgess having established this distinction, then enumcrated all the arches now existing or known to have existed in Rome or Italy, in chronological order. Before proceeding to the description of the principal existing arches, he described a triumphal procession, especially taking Vopiscus's account of Aurelian's triumph. After disposing of the provincial honorary arches, and some general remarks on such as might be termed mere gateways, the paper contained an historical account of the arches of Drusus, Titus, Septimius Severus, and Constantine in order, and to the historical account were added various architectonic observations, and illustrations of the ornaments which still exist upon those arches. Mr. Burgess pointed out the decline of Art in the arch of Septimius Severus, and the perfection of it in that of Constantine, which he showed to have been an arch belonging to the best age of sculpture, and was adopted but not erected by Constantine. Mr. Burgess took occasion to compare the pageantry of the Roman triumphs with the modest deportment of our commanders.

*The Iron Trade.*—The quarterly meetings of the iron masters of South Staffordshire and Shropshire were held on the 8th of April at Wolverhampton, on the 9th at Birmingham, and on the 10th at Stourbridge, and on the 11sh at Dudley. There was an evident intention on the part of the masters to keep up the prices of the last quarter. A great number of buyers present tendered orders at reduced prices, but the masters were firm, and refused to accede to a reduction, however small, upon any description of iron. There appears to have been no alternative to the determination acted upon at these meetings, owing to the high price of materials, and the difficulties which must attend any attempt to reduce wages at the present time. The prices quoted were for pig-iron, from 4*l.* 15s. to 5*l.* 10s.: bar-iron, 10*l.*; railway iron, from 10*l.* 10s. to 11*l.*

Some idca of the extent to which the price of the raw material has thus affected our iron manufactures may be formed, when we state the rates at which iron has been sold as fixed by the quarterly meetings during the last four years:—

| | Bars. | | | | | Hoop. | | | | | Pig. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £ | s. | | £ | s. | £ | s. | | £ | s. | £ | s. | | £ | s. |
| April, 1843 ...... | 4 | 10 | to | 5 | 0 | 6 | 0 | to | 6 | 10 | 3 | 10 | to | 0 | 0 |
| " 1844 ...... | 7 | 10 | to | 8 | 10 | 7 | 0 | to | 7 | 10 | 4 | 0 | to | 4 | 10 |
| " 1845 ...... | 10 | 0 | to | 11 | 10 | 11 | 0 | to | 12 | 10 | 6 | 5 | to | 6 | 10 |
| " 1846 ...... | 10 | 0 | to | 12 | 0 | 11 | 0 | to | 12 | 0 | 4 | 15 | to | 5 | 10 |

At Glasgow the prices of pig-iron have remained firm at 68s., cash for three-fifths No. 1, and two-fifths No. 3; and 69s. to 70s. cash for all No. 1, free on board.

*Summary.*—Ten thousand men are now at work on the barrage of the Nile; the fortifications of Alexandria being suspended by this diversion of the hands. The viceroy has raised M. Mougct, the French engineer who presides over the works, to the dignity of a Bey.—Alterations are about being carried into effect at the London docks, it having been decided to add another warehouse of still larger capacity than those completed last year. Workmen have already commenced excavating the ground for a building capable of holding about 15,000 tons, exclusive of the wines which will be contained in the vaults underncath, the cost is to be 90,000*l.* The engineer and architect is Mr. Nesham, and the builders Messrs. W. Cubitt and Co.—The works in connection with the enlargement of Dover harbour are in active progress. The site of the government old store-houses has been totally levelled; the sea-wall is completed; the gates at the entrance to the pent have been hung, and are nearly completed; and it is now confidently anticipated that the whole will be finished in six or eight months.—The Commissioners of Woods and Forests have determined upon adding considerably to the size of the home park, Windsor, by throwing into it the Maestricht gardens, which run for half a mile parallel with the Thames.—A contract for building the new sea-wall and esplanade on Cromer beach has been accepted in favour of Messrs. Wright and Cattermoul, of Norwich, for 2,323*l.* The new jetty is to be erected by Messrs. Witting and Smith, of Cromer, for 985*l.*—The corporation of Cork have applied to government for a loan of 4,000*l.* to build public markets: rather a novel purpose for which to solicit government assistance.—The church of Blandford St. Mary, Wilts, has been nearly destroyed by fire. The accident occurred from the pipe of the stove, which was put up through the roof adjoining the rafters, being burnt out.—An official document has lately been gazetted, authorizing the conversion of the episcopal palace in the city of Worcester into a residence for the dean.—An additional wing is proposed to be added to the Roman Catholic Cathedral of St. Chad, Birmingham. A new church also, upon a smaller scale, is to be commenced speedily, at Edgbaston.—The new barracks at Pembroke being completed, various fortifications for the protection of the naval arsenal, will shortly be commenced.—A gentleman employed by the government is now in the vicinity of Weymouth making arrangements, with a view to commencing the Portland breakwater.—Measures are now in active progress for the erection of the first two out of the four public baths contemplated in Birmingham, one near the north, the other near the south side of the town.—The new Trinity church in New York is nearly finished, and is said to be the best example of Gothic in that city. It has a tower and crocketted spire 300 feet high, and the windows are filled with stained glass.—The eastern portion of the choir of Hereford cathedral is about to be restored under the superintendence of Messrs. Cottingham and Son.—The new rolling mill at Cyfarthfa iron-works has been opened with considerable *éclat.* The building covers 34,800 superficial feet, has twenty puddling and ten balling furnaces, and is worked by a steam-engine of 240-horse power. The roofing is not less than 312 squares of 100 feet each.—Her Majesty has appointed a commission for the purpose of considering the manner in which the various railway projects having termini in the metropolis shall be dealt with. The commission consists of the Right Hon. Charles John Viscount Canning, the Right Hon. James Andrew Earl of Dalhousie, the Right Hon. the Lord Mayor of the city of London, the Right Hon. John Charles Herries, and Sir John Mark Frederic Smith, Lieutenant-Colonel of the Royal Corps of Engineers.—Mr. Bridges has commenced erecting the additional wing of the Cirencester Royal Agricultural College. It is expected that it will be finished by the autumn.—The coffer-dam in connection with the harbour improvements at Aberdeen, which we lately inspected, is now complete, and has proved perfectly water-tight.—The subject of the improvement of the port of Colchester having been referred to the Admiralty, in compliance with the standing orders of the House of Commons, their lordships have appointed Captain Washington, R.N., one of the Tidal harbour commissioners, and Captain Vetch, of the Royal Engineers, to inspect the river, and report on the proposed plan.—Nineteen labourers, while excavating a tunnel at Courcelles, near Paris, were inclosed by the falling in of a considerable quantity of earth and sand. By means of a water-course they held communication with those who came to their assistance, and complained most of the want of air. The chief engineer instantly bored through from the surface down to that part of the tunnel in which they were. The last accounts state, that the men, although not then liberated, were in good health and spirits, and that the mound which inclosed them had been reduced to no greater thickness than six or seven feet.—The new theatre at Manchester has narrowly escaped entire destruction by fire. The building was saved by the supply of water from the large reservoir on the top.—The first stone in restoration of the ancient church of St. Mary Redcliffe at Bristol, was laid recently by the Mayor of Bristol, with masonic honours. Great interest seemed to be generally felt by the inhabitants, who crowded the streets and adorned the houses with banners and evergreens. Various measures have been taken to ensure the preservation of the building.—The ground has been lowered several feet all round the structure, perfect drainage has been effected, and the approaches have been improved. The architects who have been entrusted with the restoration are, Messrs. Godwin and Britton; Mr. Godwin addressed the assembly at some length on the occasion, as did also several other gentlemen who were present, officiating at the ceremony.

RAILWAYS.

*Resistance of the air to railway-trains.*—An interesting paper entitled 'Investigation of the power consumed in overcoming the inertia of railway trains, and of the resistance of the Air to the motion of railway trains at high velocities,' has lately been read before the Royal Society by P. W. Barlow, Esq. We cannot say that Mr. Barlow's investigation has in our judgment demonstrated the fact that the resistance of the air to railway trains, is less than had been imagined; nevertheless we think it right briefly to record his conclusions. The object of Mr. Barlow in this inquiry is to obtain a more correct knowledge than has hitherto been possessed of the resistance which the air opposes to the motion of locomotive engines at high velocities, and of the loss of force arising from increased back pressure, and the imperfect action of steam. For this purpose he institutes a comparison between the velocities actually acquired by railway trains with those which the theory of accelerated motion would have assigned; and his experiments are made not only on trains propelled by a locomotive engine, but also on those moving on the atmospheric railway, which latter afford valuable results inasmuch as the tractive force is not subject to the losses at high velocities necessarily incident to locomotive engines. A table is given of the theoretical velocities resulting from calculations founded on the dynamical law of constant accelerating forces in the case of trains of various weights, impelled by different tractive forces, moving from a state of rest, and is followed by another table of the observed velocities in Mr. Stephenson's experiments on the Dalkey line; the results of the comparison being that, in a distance of a mile and a quarter, the loss of velocity is about one half of the observed velocity. A series of experiments on locomotive lines is next related; but the comparison is less satisfactory than in the former case, because the tractive force cannot be so accurately estimated; it is however, sufficiently so to establish the fact that the power lost by the locomotive engine below the speed of thirty miles per hour is so small as to be scarcely appreciable; and that the time and power which are absorbed in putting a railway train in motion are almost entirely required to overcome the inertia of the train, and do not arise from any loss or imperfection of the engine. It appears from these experiments that above one fifth of the whole power exerted is consumed in putting the train in motion at the observed velocity. In the atmospheric railway, the author finds that the tractive force of a fifteen-inch pipe is so small (being less than half that of a locomotive engine) that the time of overcoming the inertia must limit the amount of traffic on a single line, especially with numerous stations. When a great velocity is obtained, the tractive force of the locomotive is much reduced, and therefore a much greater velocity can be attained on an atmospheric railway. The inquiries of the author into the amount of resistance exerted by the air on railway trains, lead him to the conclusion that on the atmospheric railway the loss of the tractive power of the piston, from friction, &c. is very inconsiderable, and that the resistance of the air is less than had been hitherto estimated, not exceeding on an average ten pounds per ton on the average weight of trains. A tabular statement is then given of the results of the experiments made by the British Association for the purpose of comparison with those obtained by the author. The general conclusion which he arrives at is, that the resistance of the air in a quiescent state is less than had been previously estimated, and that the ordinary atmospheric resistance in railway progression arises from the air being generally itself in motion; and as the direction of the current is almost always oblique, from its producing increased friction in the carriages. This kind of resistance will not increase as the square of the velocity; and as it is the principal one it follows that the resistance to railway trains increases in a ratio not much higher than the velocity, and that the practical limit to the speed of railway travelling is a question, not of force but of safety.

*Traffic of Railways.*—An interesting paper has been lately read before the Statistical Society "On the profitable Increase in Traffic on Railways, as produced by Great Reductions in the Charges," by Mr. B. Williams.—The carriage of goods, the original object in the construction of railways, has been kept out of view, until lately, by the increase in passenger traffic. On the old established lines it has been proved, that the increase of nett profits from goods is greater than the increase in nett profits from passengers. A railway is a costly machine, the produce of which is cheap if it be fully employed; if idle, or working with incomplete action, a loss of interest on the outlay must be the result. The cost of conveyance admits of being separated into two elements; first, interest on capital, with certain charges, which are independent of the greater or less use made of the railway; second, the expenses that result directly from the work done. In Belgium to provide interest at 5 per cent. on the original cost of the railways, with a goods traffic per mile per annum of 40,000 tons, the charges would consist of 3d. for interest and other fixed demands, and ½d. for working expenses, making a total charge of 3½d. The actual charge was 2½d. per ton per mile, and the railways were then working at a loss, leaving in nett return, after defraying the expenses, only 2½ per cent. Yet at the very time the railways, with their superior advantages were carrying only 40,000 tons per mile per annum, the canals were carrying 400,000 tons at a charge of 1¼d. per ton per mile. Had the railways carried one half of the tonnage of the Canal company at the canal charges, instead of an annual loss of 61,000*l.*, there would have been an annual gain of 52,000*l.*

*Summary.*—Some proceedings were lately taken by persons residing at Norwood, against the Croydon Atmosperic Company, to compel them to consume the smoke of their stationary engine. In defence it was alleged that every measure had been adopted to ensure the consumption of the smoke, and that further experiments were in progress with the same object. The complaint was dismissed.—A bridge over the Newcastle and Carlisle line has given way, the recent heavy floods having deepened the river at one of the piers to such an extent, that the piles on which it was erected gave way, and two of the arches sank on the lower side of the bridge fully two feet, rendering the line impassable for the trains.—The part of the South Eastern Railway from Canterbury to Ramsgate has been opened. At a dinner given on the occasion, Mr. Macgregor, the chairman of the company said, that there would, henceforth, be a daily communication between London and Ostend by steamers in connection with the new branch line.—On the South Devon Railway at high tide, there being at the time a slight breeze, the sea lately broke down the wall near the western entrance of the Parson and Clerk Tunnel, and also displaced the iron rails and timbers of the line. Just before the accident happened, an engine was on that part of the line, and the driver was heard to express some apprehension as to its safety.—The South Western Company have determined, from the first of May, to increase the number of their trains, to accelerate their speed, and to vary the hours of departure to suit the public convenience, to carry second-class passengers with their express trains, and to abolish the slow trains altogether, and to carry third-class passengers at the parliamentary fares, with their ordinary trains, four times a day each way, and at hours to allow an early departure and late return to and fro.—At a recent meeting of the Town Council at Hull, a letter accompanied by plans was read from F. Rosenberg and John Malan, proposing the construction of a railway and tunnel for connecting the Hull and Selby Railway with the Victoria Dock and the east side of the town of Hull. A plan was also submitted by the same parties, for a new dock proposed to be erected on the Foreshore of the garrison.—A letter addressed to the proprietors of the Great Western Railway by "One of Yourselves," has, within the last week, gone the round of the London press in the form of an advertisement. The object of the writer is to induce his brother shareholders to come to a ready and reasonable decision, on the guage question. He traces the history of the broad guage, dwells upon its origin, gives its money value as compared with the narrow, and points to its engineering results with respect to economy, celerity, safety, &c. After referring to the recommendation of the Guage Commissioners that some equitable means should be found for producing uniformity of guage, he foretells that, if this advice be not acted upon, other companies will be too ready to lay down an opposition line on the narrow guage.—The cost of haulage and maintenance upon the Croydon Atmospheric line during the present year, are considerably below the cost of the corresponding items during the last year upon the locomotive line of equal length. The number of trains are advertised to be increased to 40 per diem. each way. The time by the usual trains for the 10½ miles is 32 to 35 minutes, and by the express trains a maximum speed of 60, and, in some instances, of 70 miles per hour has been attained.—On the motion of Mr. Morrison, a special committee of the House of Commons has been appointed to inquire whether, without discouraging legitimate enterprise, conditions may not be embodied in railway Acts better fitted than those hitherto inserted in them to promote and secure the interests of the public. The hon. gentleman said, "that the leading objects he had in view were to give a power of revision of fares within shorter periods than that of twenty years, the bill of last year being evidently a failure, there being at this moment a difference in some cases to the extent of 250 per cent. in the fares charged by different railways; and also, that hereafter railway acts should pass only on the conditton of terminable leases; that the acts should be for forty years, or thereabouts, similar to the system existing in France.—In reference to railway bridges, Mr. Blair writes to the *Manchester Guardian* to the following effect: Having recently had occasion to inspect the viaduct at Stockport, I was greatly surprised to find that the means of drainage for the surface-water of the roadway (railway), is totally inadequate for its intended purpose; the consequence is, that the water is *constantly percolating through* the arches, and thereby materially endangering the safety of the fabric. It is well known that water has the effect of disintegrating the particles which compose any mortar or cement. Now it must be manifest that as soon as this is effectually accomplished, the brickwork of the arch will have nothing to bind it together; consequently, if there be any great weight passing over the arch, is it not more than likely to cause a failure? The extent of the evil to which I allude is greater in some parts of the viaduct than at others, and appears to deserve especial attention, when we consider that the water is silently but *surely* doing so much mischief, and the awful sacrifice of life that might take place, in case of a downfall. It is not my wish to create unnecessary alarm; but a sense of duty induces me to record the above facts, in the hope that the railway company will investigate the subject. Since writing the above, I have examined the viaduct over the river Tame, at Guide Bridge on the Sheffield (main) line, and find that several of the arches have become *deformed;* as a remedy for this evil, large balks of timber have been introduced between the piers! I have no hesitation in adding that the above failure arises from a similar cause to that of the Stockport viaduct.

### ENGINEERING.

*The "Odin" Steam Frigate.*—This vessel, designed by Mr. Fincham, and of which the keel was laid in February, 1845, is now about ready for launching. The following are the chief dimensions:—

| | | |
|---|---|---|
| Length between perpendiculars ... ... | 208 ft. | 0 in. |
| Length of keel for tonnage ... ... ... | 183 | $8\frac{1}{4}$ |
| Breadth extreme ... ... ... ... | 37 | 0 |
| Breadth for tonnage ... ... ... ... | 36 | 6 |
| Breadth moulded ... ... ... ... | 35 | 10 |
| Depth in hold ... ... ... ... ... | 24 | 2 |
| Burden in tons ... ... ... | 1,326 4-94. | |
| Horse power ... ... ... ... | 500. | |

We have inspected the engines of the "Odin," which have heen constructed hy Mr. Fairbairn, at Manchester. They are of the *Gorgon* kind, but are much superior to Messrs. Seaward's *Gorgon* performances, and are in every way a creditable specimen of engine work. The cylinders are 88 inches in diameter, and the length of stroke 5 feet 9 inches, which, hy the *Artizan* method of computation, gives a power of 590 horses, instead of 500 horses as stated ahove.

*The "Sidon" Steam Frigate.*— This vessel, constructed after a plan of Sir Charles Napier's, is nearly ready for the reception of her engines, though only put on the stocks in June, 1845. The following are the chief dimensions:—

| | | |
|---|---|---|
| Length between perpendiculars ... ... | 210 ft. | 9 |
| Ditto of keel for tonnage ... ... ... | 185 | $9\frac{3}{4}$ |
| Breadth extreme ... ... ... ... | 37 | 0 |
| Ditto for tonnage ... ... ... ... | 36 | 6 |
| Ditto moulded ... ... ... ... ... | 35 | 10 |
| Depth in hold ... ... ... ... ... | 27 | 0 |
| Burden in tons... ... ... | 1,328 67-94 | |
| Horse power ... ... ... ... | 560 | |

Although only two feet longer, and two feet broader than the Odin, the Sidon is intended to carry 400 tons more coals.

*The Termagant Steam Frigate.*—The Termagant steam-frigate, constructing from a design by Mr. White, builder at Cowes, is a vessel of the same length as the Odin, designed by Mr. Fincham; but 3 feet six inches greater dimensions in her extreme breadth, and will have engines of six hundred horse-power. The following are her dimensions:—

| | | |
|---|---|---|
| Length between perpendiculars ... | 208 ft. | 3 in. |
| Length of keel for tonnage ... | 181 | 0 |
| Breadth extreme ... ... | 40 | 6 |
| Breadth for tonnage ... ... | 40 | 0 |
| Breadth moulded ... ... | 39 | 4 |
| Depth in hold ... ... ... | 25 | 9 |
| Burden in tons ... ... ... | 1,540 40-94 | |

*Samson and Bull Dog.*—The following are the chief dimensions of the *Samson* and *Bull Dog* steam-frigates, the engines of which have heen constructed hy Messrs. Rennie:—

| | *Samson.* ft. | in. | | *Bull Dog.* ft. | in. |
|---|---|---|---|---|---|
| Length hetween perpendiculars ... | 203 | 6 | ... | 190 | 0 |
| Ditto keel, for tonnage ... ... | 178 | 5 | ... | 166 | $2\frac{1}{8}$ |
| Breadth, extreme ... ... ... | 37 | 6 | ... | 36 | $0\frac{1}{4}$ |
| Ditto for tonnage ... ... ... | 37 | 0 | ... | 35 | $8\frac{1}{4}$ |
| Depth of hold ... ... ... | 23 | 0 | ... | 21 | 0 |
| | tons. | | | tons. | |
| Burden in tons, old measurement | $1229\frac{40}{94}$ | | ... | $1124\frac{34}{94}$ | |
| Ditto new measurement | 1240 | | ... | $1069\frac{87}{94}$ | |

| Armament. | | | Armament. | | length. |
|---|---|---|---|---|---|
| | cwt. | lhs. | | cwt. | ft. |
| 2 guns 8 in. hore | 112 each. | 2 42 | guns | 84 each | 10 |
| 4 ditto on pivots | 65 „ | 2 68 | ditto | 64 „ | 9 |
| 2 24-pounders | | 2 42 | carronades | 22 „ | 0 |
| Engines direct action, flue boiler, 450 H.P. weight with water, 526 tons. | | | Engines, 500 H.P. | | |

*French Line of Packets to the West Indies.*—The committee of the French Chamber of Deputies on the transatlantic packet boats suggests, that the minister be authorized to treat with one or several commercial companies for supplying the four principal lines, viz., New York, the West Indies, Rio Janeiro, and the Havannah, with steam or sailing boats. The company bidding shall not be obliged to have more than two points of departure, Havre and Marseilles. The speed of these boats to be, at least, nine marine miles an hour, but they are not to be permitted to carry more than 200 tons of merchandize. The passage between Havre and the West Indies is to he performed within twenty days, and between Havre and the Havannah, and Havre and Rio Janeiro, in twenty-seven days. It appears probable, that these vessels will be furnished with the screw propeller. They will hc formidable competitors of the West India mail packets, if the scheme be really carried into effect.

### MISCELLANEA.

Sir Thomas Cochrane has lately visited the island of Formosa, with the view of ascertaining the truth of the report respecting the existence of coal in that locality. The report on the subject was found to hc correct in every particular, and large quantities of the mineral were discovered a few miles from the beach.—The British and the French governments have granted permission to two gentlemen, the projectors of the sub-marine Telegraph to lay it down from coast to coast. The site selected is from Cape Grisnez, or from Cape Blancnez on the French side, to the South Forcland on the English coast. The soundings between these headlands are gradual, varying from 7 fathoms near the shore on either side, to a maximum of 37 fathoms in mid-channel. The Lords of the Admiralty have also granted permission to the same gentlemen to lay down a suhmarine telegraph between Dublin and Holyhead, which is to be carried on from the latter place to Liverpool and London.—Colonel Sabine suggests that our extraordinary mild winter may have had as a cause the fact of the Gulf Stream having extended further to the northward and eastward of the Azores than usual; and this, it seems, was the case in the winter of 1821-2, which was also remarkable for its mildness. This extension of the Gulf-stream current may have some connection with the unusual inset into the Bay of Biscay, referred to in another page, by which the loss of the Great Liverpool is said to have been occasioned.—The journals of St. Petersburgh speak of an Electrophonic telegraph, the invention of the Chevalier Lasckott, which Professor Jacobi has presented to the Imperial Academy of that city. It is composed of a clavier of ten keys, ten bells of different sizes and ten conducting wires; through whose means the letters of the alphabet and the words they form are expressed hy sounds and harmonies.—The city of New York possessed some time since floating hotels and taverns, and even a floating theatre, but lately even a floating manufactory has heen estahlished in the steamer *Ohio*, on the river of the same name. It is a glass-furnace, in which the work is mostly done in the night, while the ship is at anchor, the day being destined for selling the glass on the hanks of the river where passengers are also conveyed.—The largest and most powerful steam-hammer which Mr. James Nasmyth has as yet constructed, has heen set to work last Saturday week at Sir John Guest's extensive iron works at Dowlais. The hammer is upwards of six tons weight, with a fall of seven feet perpendicular. The anvil is supposed hy people who know no better to be the largest casting in the world, being thirty-six tons weight; but the great hell of Moscow weighs 150 tons, and there are numberless castings in the world far heavier than that whose dimensions are here made the subject of hoast. The founders England do not yet know what large castings are. —The royal gardens at Cumherland-lodge are to be hroken up, and the materials of the orangeries, the hot-houses, and the pinery are directed to he sold. The celehrated vine nearly one hundred feet in length, which produced last year upwards of 2000 bunches of grapes is to be preserved. —Mr. Brotherton has just obtained a return of the number of pounds of cotton twist and yarn exported for a lengthened period. The hon. member asked for a return from 1800, to 1845, but it appears that the accounts at the Custom-house were destroyed hy fire of the years preceding 1814. The accounts are given in the return from that year to 1845. The quantity exported in 1845. was in pounds, 135,144,865, and in value 6,963,235*l*.—A letter from Trieste, published in the *Gazette de Cologne* and quoted hy the *Times*, says a service of steamers is to be established between Trieste and Alexandria, the expense of which is to be borne conjointly by the British government and the *Times*. The departures will be twice a month. The agreement is to last six months, and has been entered into to prove beyond dispute, the superiority of the Trieste route over that of Marseilles.—Dr. Bessel died at Konigsberg on the evening of the 17th March. He was a member of most of the learned societies in Europe, and contributed greatly to the advancement of astronomy. He laid down the exact position of tens of thousands of stars, for which he received, in 1829, the gold medal of the Astronomical Society of London. Having obtained instruments of great power and accuracy, he directed his attention to the remarkahle star, 61 Cygni, to endeavour, if possible, to ascertain the least apparent parallax; and after three years of patient observations, his labours were crowned with so much success, that another gold medal was presented to him. From these observations it appears, that the distance of this star from the earth is nearly 670,000 times that of the sun; and it is the first fixed star whose distance has heen ascertained. His health had been declining for some years, and he had suffered greatly, but his death was gentle. He was in the stxty-second year of his age.—A heautiful large iron steamer has lately heen launched from the building-yard of Messrs. James Hodgson and Co., Liverpool, called the *Antelope*. She is the first of a line of eight steamers, on the screw principle, which are intended to ply between that port and Brazil. She is 600 tons hurden, 175 feet long, 26 feet 4 inches in heam, and 17 feet deep in hold. Her propeller will be worked by a pair of engines of 100 horse power, or 50 horse power each. She is to be rigged as a ship, with very heavy masts and rigging.—The establishment of livrets or small agreement hooks between masters and men has been so unpalatable to the working-men of the French metropolis, that the government has delayed their introduction until next year.

# THE ARTIZAN.

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## Art. I.—MANAGEMENT OF ENGINE FACTORIES.

To make money by the fabrication of engines, it is necessary to manufacture and not to make them; and those persons generally will make the most money who are content to look upon the business as a trade, and not as a profession. A certain type of engine should be adopted and preserved without alteration, until it becomes so antiquated that people will have it no longer. To the production of this form of engine the various tools must be adapted, and tools may be devised to form the several parts with the utmost exactitude and rapidity, and with the smallest possible amount of manual labour. The production of engines under such circumstances will become a manufacture, and will be attended with the same results, both in the cheapness of the process, and the excellence of the product, as in the case of weaving or spinning by steam instead of by hand power. To produce engines cheaply, and of good quality, tools must be employed which are not only of great capabilities, but which are specifically adapted to the end in view; but it would not pay to construct such tools for the production of only a few engines; and as the tools can neither be changed nor discarded without loss, it is necessary to persist in the manufacture of the same description of engine as long as possible, or until the savings from the use of the tools employed have covered their expense.

It is impossible for us to give any general rules for the construction of factories, for much depends upon the kind and extent of business contemplated, and something also upon the situation. It is most important, however, that a factory should be so easily accessible, both by water and by railway, as to obviate heavy expenses for carriage; and it may for the most part be concluded, that a factory is ineligibly situated which requires to spend anything in cartage. In some cases the expense of carriage is so great as to constitute a considerable per centage upon the capital invested; and, unlike most other errors, the necessity of cartage, from the badness of the situation, is an error that cannot be retrieved. Abundance of water is a good feature; and, in most cases, a promontory or peninsula in a harbour or river will be found to be an eligible locality.—But we fear these directions are of too general a character to be of much utility; and we shall therefore, give a description of a hypothetical factory, such as would be suitable for the manufacture of land, marine, and locomotive engines, with a yard for the construction of iron ships; and though not suitable for every case, it may serve as a type, to the features of which other factories may be made to conform as far as the circumstances will permit.

At right angles with the shore, a long wet dock extends into the land, bounded on the left hand with a parallelogram of buildings divided crossways into three squares. In the first of these squares, and facing the shore, the entrance gate is situated; and at the opposite side of the square is the fitting shop for the heavy engines. Adjoining the gate, on each side, are offices and warehouses, and the dwelling of the manager of the works. On the left-hand side of the square is a range of buildings, on the ground floor of which the planing and boring machines and other heavy tools are set, and in the superior stories are small lathes and finishing workshops. On the other side of the square is a range of buildings, the ground floor of which is devoted to the fitting together of locomotive engines; above this shop the pattern shop, and the place for keeping the patterns, are situated. This completes the first square. The second square is larger than the first, and is bounded on the front by the fitting shop, which separates it from the first square, and at the back by the foundry. The sides of this square are occupied by smiths' shops, by body makers' shops for the construction of locomotive carriages and waggons, and by painting shops, in which the carriages are painted, stuffed, and finished. All these buildings are only of one story, are turned with their gables towards the square, and are lighted from the roof. Rails are laid across the square, with turn-tables at suitable intervals, so that any carriage in any one shed may be easily shifted into any other. For the body makers, lathes and circular saws, drilling and mortising machines are provided, so that the only manual labour required is to put the parts together. At the end of the range of smiths' shops, the rolling mill and forge hammers are placed. The smiths' fires are most conveniently blown by a fan-blast. The forge hammers are worked by means of the atmospheric pressure, which also drives the machines in the boiler shed, and appears calculated to supersede, in many cases, the usual modes of giving motion to machines. Behind the foundry the third square is situated, and its chief use is to hold the foundry boxes; the sides of this square are occupied by shops for the brass founder, the copper smith, the maker and mender of loam boards, the foundry smith, &c., and a place is also provided for the clay mill. In the centre of the square is a triangle for breaking iron: the back end of the square is left vacant, to facilitate future additions.

Between the wet dock and the side of these squares of building is a quay, alongside which vessels lie to get in their engines; the end of the fitting shop is turned to this quay. Instead of cranes in the fitting shop, winches travelling on beams, such as are now generally used by masons, are employed, and these beams extend through the end of the house and across the quay to the dock, so that a piece of machinery may be lifted in the fitting-shop and deposited within the vessel in the dock, without the necessity of any intermediate process. To support the beams carrying the travelling winches outside the house, pillars stand on the edge of the quay, and the portion of the beams which hang over the quay, are securely trussed by means of iron rods. The roof is continued along over the beams, both to give increased strength and to protect the workmen from the wet, when putting engines on board.

On the opposite side of the dock is the boiler shed, and in continuation of it is the building yard. The boiler shed is a very large structure; it contains smiths' shops for preparing the smith work necessary for boilers and iron ships, and is provided with rivetting and punching machines, and other necessary implements. The boiler shed is lighted from the roof, and the boilers are lifted by means of a travelling carriage running on beams near the roof, arranged as in the fitting shop, and similarly projecting over the dock, so as to put boilers on board. The whole of the roofs are made of iron, which are as cheap as timber roofs, and greatly preferable in every way. A railway runs round the dock, and doors open to the wharf from the foundry, carriage shop, and locomotive shop; so that any heavy article, whether engine, boiler, locomotive, railway carriage, or casting, may be set either on board ship, or on a railway, without incurring the trouble and expense of intermediate removal.

*Manufacture of Engines.*—The best situation for an extensive engine factory, intended for the production of marine and locomotive, as well as of land engines, appears to be in a coal and iron district open to the sea, and affording easy means of inland transport, both by railway and canal. Large towns are not eligible situations for such engine works as depend more upon the production of new articles than the repair of old ones; for in large towns the cost of subsistence is greater than in secluded districts, and the wages of the operative must be higher to purchase the same amount of comfort, or else his comforts must be diminished. In rural situations, too, the working population need not be crowded into the narrow compass they are compelled to be content with in large towns: every man may have a separate house, and every house may have a garden; and a guarantee is acquired for the sobriety and good conduct of the working man in the comforts with which he is surrounded. Men are migratory and intemperate because their homes in large towns are such as to be necessarily distasteful to them; and a factory aspiring to have skilful and respectable men, should be prepared to make some sacrifice towards promoting the improvement of their social condition. A rural factory is the best adapted for carrying these views into effect; and, by selecting a coal and iron district, the expense of transporting these materials to the seat of manufacture is saved. The place selected should be open to the sea, so as to enable vessels to be freighted with machinery intended for distant places at a quay alongside the works, and also to enable iron steam vessels to be fitted with their engines without requiring to send either men or materials from the factory. The paddle-wheels and the boilers of marine engines cannot be carried by canal without great inconvenience; and it is only by so placing the factory that vessels can come up to its quays, that expense and inconvenience from such sources are to be avoided. A yard for the construction of iron ships again forms a very natural appendage to an engine factory; but such an appendage cannot exist unless the locality chosen be open to the sea.

But although we consider the sea coast of a coal and iron district to be the best situation for an extensive engine factory, we do not conceive that the supreme direction should be located in so secluded a place. London should be the head quarters of the management of English factories, because there the best orders are to be had, and there the improvements of the age concentre. Obscurity is more likely to overtake a provincial engine factory, if it be not well represented in London; and the persons giving orders for engines generally desire to confer with the managers, who must be at hand to make such interviews possible. In London the plans must be fixed and the drawings made, and they can then be sent into the country for execution. This, we believe, is the method pursued by Messrs. Boulton and Watt, whose engines intended for the London market, though manufactured at Soho, near Birmingham, are, we understand, designed by the members of the firm resident in London, whereby Messrs. Boulton and Watt combine the advantages of metropolitan representation with rural manufacture. In such cases it appears expedient to have a small factory upon the spot for repairs: Messrs. Boulton and Watt have a hulk for this purpose, fitted up internally as workshops, and provided with shear legs for moving heavy weights. In the selection of a metropolitan workshop for the accomplishment of repairs, much must, of course, depend upon the extent and precise nature of the trade. If contracts exist for the repair of locomotives, it appears expedient, in the present condition of metropolitan railways, to repair the locomotives of each railway in a workshop on the line; but such would no longer be the case if a suburban railway were to be made, connecting together the different termini. In that case the whole of the repairs should be executed in one factory, and that factory should be so situated as to be available for the repair of steam vessels as well as of railway locomotives. In such a factory it would be desirable to have the addition of a foundry and forge hammer, but, under other circumstances, it would be preferable to dispense with such aids, as too powerful for the occasion.

The loose system pursued in some factories, of allowing the inferior foremen or workmen to fix the shape and dimensions of cocks, bolts, and other subordinate parts, is one likely to lead to much confusion, and is not to be commended. Every thing should be drawn in the drawing-office, even the spanners, oil-cups, and gauge-cocks; and for any misfit, the person who has made the drawing should be responsible, provided his dimensions have been followed. It should be the part of the foreman not to design portions of the work, but to see the work properly executed; and no foreman should be permitted to alter or add to a drawing on any accoont whatever. Should he perceive any mistake or omission, he should come to the drawing-office to have the requisite alteration made, but should not be suffered to make it himself. It is only by a rigorous adherence to this plan that mistakes and confusion are to be avoided, or that an accurate record can be kept of the work which has been done, The practice with the London engineers is to make their working drawings to a scale of $1\frac{1}{2}$ inches to the foot,—representing portions, however, of such parts as the top ends of the side rods, bottom of connecting rod, &c., of which the form cannot readily be found from the measurements of a rule, of the full size. The drawings are fixed upon boards, and varnished so as to preserve them from the effects of grease; and a ledge of wood is nailed round the edges to keep them down, and prevent the drawing from being rubbed when the boards are piled one upon another. Erection drawings should be given to the foreman of the erecting shop, with all the centres marked in their proper places; and the size should be given to which the cylinder is to be *cast*, as well as the size to which it is to be *bored*. Every erector should have a box for holding his hammers, chisels, and files; and every finisher a drawer for holding his tools. Steel straight edges are preferable to wooden ones for most purposes, and the different workshops should be supplied with them. All tools going out of the factory should be weighed, and weighed again when they are brought back. It will generally be found the best economy for factories to make their own gas, and all the workshops should be well lighted, so as to save candles. Flexible tubes, fitted at the ends with heavy candlesticks, will be necessary to supply gas for the erectors.

To make the manufacture of engines profitable, it is necessary to be able to get good orders, and to be able to manufacture cheaply. Orders are most easily got by makers who have a name: yet a name is not in all cases of itself a sufficient attraction, and other allurements must be presented. The ability to give money accommodation will, in many cases, establish a preference, but the chief reliance should be placed upon the activity of the managing head, who, with competent engineering knowledge, should be a thorough man of business, and whose function it should be to agitate unceasingly among the persons likely to require engines made. In fixing the plan of engine, the highest scientific attainments should be put in requisition; but the plan once fixed, the production of engines ceases to be a profession, and is as much a trade as building or weaving, and, to be profitable, must be pursued on the same system. A fastidious taste, or a wavering disposition, are only barriers to commercial success; and those will make most money who, instead of distracting themselves among superlative refinements, will look chiefly to getting the work done. Improvements have their price as well as their recompence, and, to be profitable, they must be introduced at rare intervals, and then only after they have been satisfactorily tested, so that their success is certain. In their designs and their model experiments, engineers may be as revolutionary as they please; but a manufactory shonld be a conservative institution, and can never be made profitable amid perpetual changes. The form selected should be preserved intact until the accumulation of new improvements is such as to justify and compel the introduction of another combination, which should in its turn be retained until a new crop of improvements has been raised equal in value to the former. Manufacture is thus reconciled with progress; and the alternative is averted of tedious and expensive production, or a gradual lapse into antiquity.

The most important element of prosperity, however, in the conduct of factories that we can discern, is that of making the workmen employed participators in the profits realised, whereby their energies are effectually enlisted, and their ingenuity stimulated to the device of cheaper methods of manufacture. If this innovation be generally carried into effect, strikes will become impossible: and the ingenuity of the workmen, at present a barren field, will spring up into new forms of life and productiveness. The collective inventive genius of the operative classes is a mine of unspeakable wealth, and will at once be rendered available by making it the interest of the workman to plan cheaper methods of manufacture. The *managers* of factories are generally made participators in the profits realised, and the most beneficial results have sprung from the arrangement; but the principle has not been generally extended to the workmen, though recent experiments show that, in their case, it might be applied with equal advantage. M. Leclaire, a house painter in Paris, has for some years made his workmen participators in the profits of his establishment; and, in a pamphlet recently published, he speaks of the system in the highest terms of praise. Lord Wallscourt has long pursued a similar plan in the cultivation of his estates in Ireland, as has already been mentioned in the present volume of the *Artizan*, page 23, and its operation has been such as to stimulate the supine Irish peasant into active industry, and to shed prosperity and gladness over a district that was formerly the abode of famine and despair.

Such, then, are the chief considerations which suggest themselves to us in connection with the management of factories. The factory should be commodiously situated, and should aim at the production of large quantities of the same kind of work, so that the requisite tools and appliances may be introduced to make the production a manufacture, and the men will only have tasks to perform with which they have long been familiar. So soon as the plan is settled, all considerations of scientific excellence should be dismissed, and the work should be conducted as if the only object to be considered were the production, at the cheapest rate, of certain hundreds of tons of finished castings and polished smith work. Of course quality must not be sacrificed in the aspiration after cheapness; but the quality being fixed, the question is how to produce the articles required at the cheapest rate. We believe that the adoption of the principle of dividing the profits with the workmen, will add to the employer's gains, and diminish his anxieties; while to the workman it will bring such ameliorations as will at once place him in his true position in society. With the termination of the existing system, the strife now subsisting between masters and men must cease, and they will be knit together for the future by an identity of interests, which will gradually grow up into a mutual confidence and regard.

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## ART. II.—MANCHESTER SCHOOL OF DESIGN.

THERE appears to have been some misunderstanding as to the method of conducting this school: Mr. Wallis, the head master, lately resigned, and has since issued a letter explanatory of the reasons of his resignation, which appears to us to be by no means sufficient. The London council have lately begun to teach the figure simultaneously with the other branches of education, and in a manner which Mr. Wallis considers is more likely to induce bad than good results. He preferred to let the student commence with ornamental drawings, confining the figure to those whose pursuits rendered it an essential advantage, and leaving it till the conclusion of the student's course, when it would be taught on sound principles, commencing from the skeleton. Accordingly, and as the Manchester council did not feel inclined to dispense with assistance from Somerset House, Mr. Wallis resigned, a step which has been greatly regretted in Manchester. Mr. Jackson, the active honorary secretary has also seceded. Whatever opinion Mr, Wallis might entertain respecting the points on which he differed from the council, he had no right, we conceive, to expect that the general system should be broken in upon to meet the views of an individual instructor. If Mr. Wallis' departures had been sanctioned, on what plea could other departures, less judicious, perhaps, but equally prized by their projectors, be forbidden? And, must not there be an end to all system and concert if every innovator is to be permitted to introduce his fancies? If there is any flaw in the general system let it be amended; but it cannot be tolerated that every master should set up an idol of his own, and claim for it the adoration of those whom it is his duty to educate in the general faith. It is like a Bishop preaching Mahommed.

Mr. Henry Johnston has been appointed Mr. Wallis' successor, and he has lately delivered an introductory address on assuming the functions of his office.

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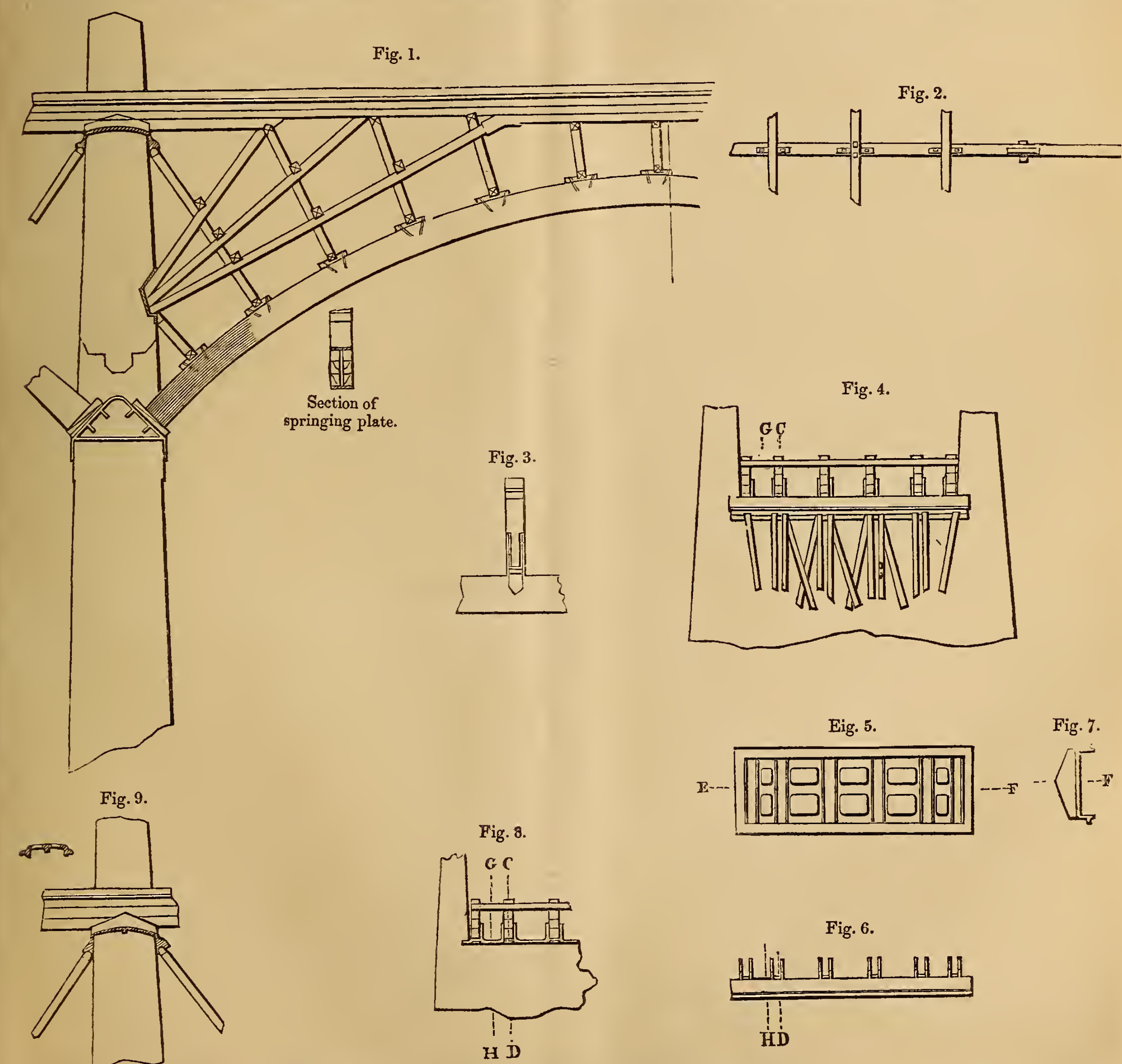
## Art. III.—DETAILS OF TIMBER BRIDGE OVER THE CALDER.

At page 175 of the present series we gave specimens of various timber viaducts applicable to railway purposes. We now give some details on a larger scale of a similar structure erected by Sir John Macneill on the line of the Wishaw and Coltness railway, where it crosses the river Calder. The bridge is of the plank arch description, with arches of 100 feet span. Each arch is constructed with six ribs, each formed of twelve 3 in. planks laid together so as to form a curved beam 36 in. deep and 12 in. broad. These arches abut against springing plates secured into the piers, which are perforated to receive them. Upon the arches, radiating from their centre, are placed struts 9 in. by 11 in., resting upon cross bearers of the same dimensions, which are slightly checked into pieces 3 ft. 6 in. long, and 6 in. broad, fastened upon the planks forming the arch. These pieces serve to distribute the weight of the roadway, which rests upon the upper end of the struts by the aid of cross pieces similar to those at the bottom ends. The haunch of the arch is prevented from springing by some of the struts which radiate from the centre of the arch abutting against the pier; one set terminating in a socket on the pier cap.

About 9 ft. above the springing plate a cast iron socket plate is let into the pier, out of which diagonal struts diverge and terminate at the roadway. These diagonals are tied to the radiating struts by means of cross pieces 9 in. square which are slightly checked into both at their intersections in the vertical plane. The lower balk of the roadway is not continuous, consisting of pieces 32 ft. long, laid upon the pier, and pieces 35 ft. long, resting on the crown of the arch and supported at the ends by the diagonal struts.

The description will be readily understood by a reference to the cuts. Fig. 1, is a longitudinal section of the pier and part of the arch; in the line *C. D.* of Figs. 4, 5, 6. Fig. 2, is a plan of one of the ribs of the arch, with the cross bearers laid on it. Fig. 3, is an elevation of the pier aperture and springing plate. Fig. 4, is an elevation of the side pier cap, showing the radiating frame abutting against it. Fig. 5, is a plan, and Fig. 6, an elevation of the pier cap, of which Fig. 7, is an end view. Fig. 8, is a section of the pier and pier plate in the line *E. F.* Fig. 5. Fig. 9, is a longitudinal section of the pier and pier plate, in the line *G. H.* Figs. 4, 5, 6.




DETAILS OF TIMBER BRIDGE ON THE WISHAM AND COLTNESS RAILWAY.

## Art. IV.—VARIETIES OF EXPANSION GEAR.

Slide-Valves are the most satisfactory species of expansion-valve; but spindle-valves are the simplest, and they are the most frequently employed. Most of the spindle expansion-valves are of the double beat or equilibrium kind, such as are used in the Cornish engines. In Maudslay's portable engine the cam is moved on the shaft by the governor, and the speed of the engine regulates the point at which the steam is cut off. The form of the cam is a sort of twisted elliptical cylinder, so to speak, against the exterior surface of which a pulley fixed on the end of a lever, presses, and by the motion thus derived opens the valve. This species of cam was employed in the Berenice steam vessel, by Mr. Robert Napier, but the valve was in that case a slide-valve, consisting of a plate interposed between the face of the valve and the face of the cylinder.

The expansion valve of the American engines is generally a disc turning upon an axis like a throttle-valve, but so made as to be capable of being turned completely round in the pipe. The expansion-valve of the Don Juan was of this description, and was worked from a pin in a pinion, which made two turns for each revolution of the engine. In Mr. James Whitelaw's expansion-valve the valve shaft is cranked slightly, so as to enable the end of a double-ended lever to be in the centre line of the shaft, the centre of this lever being supported by a pin passing through the valve levers, and the expansion-valve, which consists of a plate placed between the valve and cylinder faces, is hung from the other extremity. So long as the end of the lever which is situated in the central line of the valve shaft, is preserved stationary, the expansion-valve has the same motion as the other valve, or is relatively at rest, so that no expansion then takes place; but if the end referred to of the lever be moved, as is done by means of a suitable cam upon the shaft, expansion answerable to the degree of motion is then accomplished. Some expansion-valves are gridiron valves, or valves consisting of a great number of ports instead of one, whereby the extent of travel necessary for their action is diminished. Mr. Bourne has introduced into some steam vessels a species of expansion-valve which cuts off the steam close to the valve face, so as to prevent expansion in the valve-casing, and is easily applicable to existing engines. It consists of two plates, moving between the valve tails of the D valve, and shutting up against the lap. These plates are connected together by a rod, and motion is given to them by means of a suitable cam or tappet: for moderate rates of expansion the motion given by a tumbler will suffice. In engines with a considerable amount of lap upon the slide valve, the amount of expansion will be increased by partially closing the throttle-valve, and in such cases the use of an expansion-valve in the steam-pipe cannot be productive of much benefit.

Variable expansion gear has been extensively introduced in locomotives.—The variable expansion gear of Gonzenbach consists of an ordinary short slide-valve and casing, with ports in the back, upon which another slide-valve and casing are imposed. The ordinary valve is worked in the usual manner; but the travel of the supplementary valve may be lengthened or shortened, so as to cut off the steam at any part of the stroke. The supplementary valve is a solid block with two perforations, which, when opposite the ports in the cover, admit steam from the supplementary valve-chest. The starting-handle is connected with a shaft, upon which a lever is fixed, and so connected by links with the extremities of the eccentric rods, that when one eccentric notch is in gear with the stud, upon the valve-lever, the other shall be disengaged. Where the engine is in gear for going a-head, the reversing eccentric rod is disengaged from the ordinary valve, and in gear with the supplementary valve, by means of a second notch, which receives a pin upon the expansion-valve lever. In this lever there is a long slot, in which a pin, fixed on the valve-link, may be moved to a greater or less distance from the centre of the expansion-valve shaft, by means of the handle; and the effective length of the valve-lever being thus varied, the travel of the valve receives a corresponding variation. The expansion-valve thus receives the reversing motion while the slide-valve is receiving the forward motion.

The variable expansion gear of Mayer consists of an ordinary valve, with the addition of perforations through the top and bottom faces, each of which is covered by a supplementary valve upon the back of the first, consisting of two solid blocks, into which a valve rod is screwed, having a right-handed screw where it penetrates the one block, and a left-handed screw where it penetrates the other; so that the blocks will be set closer or further apart, according to the direction in which the rod is turned. The ordinary valve receives its motion in the usual way, and the expansion valve is moved by means of a pin attached to the piston-rod, which works in a slotted lever, to which the expansion-valve rod is attached. The motion of the two valves is, therefore, at right angles, and the expansion-valve is about one-fourth of a revolution in advance of the steam-valve.

Mr. Cabrey has used a mode of obtaining expansive action, which bears some resemblance to Gonzenbach's plan, but dispensing with a second valve. It consists simply in making the eccentric rod terminate in a pin working in a slotted valve-lever, which has a notch similar to the ordinary eccentric rod. The throw of the valve will therefore depend upon the position of the eccentric pin in the slot; for the effective length of the lever will vary with the distance of the pin from the centre of the valve shaft; and the nearer it approaches that, the smaller will the throw become. By this means expansive working can be obtained with cover on the valve, but it has the great defect of not opening the ports at the proper time. This may be obviated by increasing the lead of the eccentrics with the degree of expansion; which has been done by Mr. Fenton, by means of spiral feathers upon the crank shaft fitting into corresponding grooves in the eccentric, which, when shifted by a lever along the shaft, will necessarily be turned round upon it, and thus give the required lead.

The movement for working the valves is in some cases derived from the connecting-rod, as in the arrangement known as Melling's motion, and a somewhat similar mode of working the valve has been employed by Hawthorn, of Newcastle, which admits of expansive action. The pin in the connecting-rod works in a straight slot in a link, to which arms are attached at right angles. The extremity of the lower of these arms is connected by a link and lever to a shaft, which is worked by the reversing handle, while the upper arm is attached to a lever upon the valve-shaft. Upon this shaft there is a double-ended lever, with either end of which gears a rod, communicating with the valve, according as a forward or reverse motion is wanted. This valve-link is connected by a link with the starting-shaft. The central slot in the link permits the free end movement of the pin on the connecting-rod, while the lateral movement is communicated to the link, and made available for working the valve-levers. To reverse the engine, the inclination of the link must be altered, and the fork in gear must be changed to the other end of the lever, which is done by the same handle: the lead is regulated by the degree of inclination of the slotted link, which might be changed by lengthening the lever on the reversing-shaft connected with the lower arm of the link, or by shifting it round on the shaft so as to throw the lower arm towards the cylinder. There is much complication in this mode of working the valves; the ports, too, require to be large, and the plan has not been received with much favour.

Stephenson's link motion is the most elegant, and one of the most eligible modes of connecting the valve with the eccentric yet introduced. The valve-rod is attached by a pin to an open curved slot in a link connected at the one end with the driving eccentric rod, and at the other with the backing eccentric rod. The link with the eccentric rods is capable of being moved up or down by a rod and bell crank, while the valve-rod remains in the same horizontal plane. It is very clear that each end of the link must acquire the motion of the eccentric rod in connection with it, whatever course the central part of the link must pursue, and the valve-rod will partake most of the motion of the eccentric rod that is nearest to it. When the link is lowered down, the valve-rod will acquire the motion of the upper eccentric rod, which is that proper for going a-head; when raised up, the valve-rod will acquire the motion of the reversing eccentric, while in the central position the valve-rod will have no motion, or almost none. The link motion therefore obviates the necessity of throwing the eccentric rod out of gear; it also enables the engine to be worked to a certain extent expansively, though as a contrivance for working expansively, we cannot hold it as deserving of much commendation. The dead point of the link motion is where the line of the valve-rod bisects the angle formed by the eccentric rods. The best forms of the link motions have side studs, to which the eccentric rods are connected, and these are placed so that at the greatest throw, whether backward or forward, the valve-rod and eccentric rod are in the same straight line, and the valve receives the full throw of the eccentric. A counter-weight is also attached to the shaft to balance the weight of the link and rods.

The whole of the various expedients for the accomplishment of variable expansive action in locomotives operate either by shortening the travel of the valve, or by the introduction of superposed valves. The first mode is adopted by Stephenson and Cabrey, and the second is principally used by Mayer and Gonzenbach. In the first the effect is to uncover the steam ports less, and to re-shut them sooner, to hurry the eduction, and to compress the steam shut within the cylinder; from the early closing of the eduction, the advantages due to expansion are partly sacrificed, for the steam escapes before it has done all its work, and power is lost in the compression of vapour. The second class of expansion contrivances is not chargeable with these defects. It admits of the steam being cut off at any part of the stroke, without any derangement of the valve motion, but there is greater complication in the apparatus. In the class with variable throw, the cutting off is the result of a virtual contraction of the ports, which wire-draws the steam, increasing the speed of the entering steam, and making the pressure in the cylinder less than in the passages. In Cabrey's expansion gear, the fault is that for certain degrees of travel, and when there is much cover on the valve it may happen that instead of opening the port before the end of the stroke, the valve may not have uncovered the steam port when the piston is about to begin the return stroke. This evil results from the invariable position of the eccentrics on the shaft, and the immobility of the centre of the valve lever. Stephenson gets rid of the defects of Cabrey's system in regard to changing the lead of the eccentric, by rendering moveable the centre of oscillation of the valve lever, as the link may be considered, whereby he virtually turns round the eccentric on the axle. Mayer's gear has given very good results, and is free from the defects of Cabrey's and Stephenson's. Whatever be the degree of expansion, it presents the same area of steam port, the eduction is not unduly hurried, the linear lead is unvarying, and the compression of the steam before the piston is but small and is not liable to increase. The wheel and chain gearing, however, used in working it, are very troublesome, and liable to get out of order, and the valves have a great deal of friction. Gonzenbach's has less friction than Mayer's, and gives equally good results.

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## Art. V.—QUALIFICATIONS OF A CIVIL ENGINEER.

Civil engineering is a wide-extending field, and those who would cultivate it successfully must have large attainments. We do not indeed insist upon the necessity of the civil engineer being master of a tenth of the various kinds of knowledge which Vitruvius says, are indispensable to the architect—and the best architects we believe, if the truth were spoken, would rarely be found to be so endowed; nevertheless, the profession of civil engineer requires a general acquaintance with most of the departments of physical science, and a perfect familiarity with the arts of construction. The first qualifications, however, of the civil engineer, and without which all other attainments will be of little avail, are sound sense and extreme circumspection. He must risk nothing, and attempt nothing where he does not perfectly see his way; and an engineer is not to be trusted who has not a large proportion of moral fear. The deductions of science, though useful, are not to be trusted without the confirmations afforded by experience; and as a general rule, an engineer should be content in his first works with following in the footsteps of his predecessors. Time and experience will bring the confidence that can alone justify a change, but changes must be gradually and cautiously introduced to obviate the risk of occasional failure. Rash innovators will speedily forfeit the public confidence, nor will it avail an engineer much to be reckoned clever unless he be also reckoned sound. The effect of such a distinction is to be praised, admired, and left unemployed.

The most successful engineers are those who have risen from the condition of working men and whose stock of school learning was by no means considerable; nevertheless, those persons have in every instance been well acquainted with the leading principles of physical science in whatever manner they may have acquired their information, while their knowledge of details has in every case been such as to enable them in all relating to practical execution to innovate with safety. Watt's practice presents one of the most prominent examples of adventure and progress united with circumspection and care. There was no limit to his speculations, but he tried nothing which had not been well matured and presented a strong prospect of success, and it was only after a prolonged and careful private trial that the innovation was introduced in practice. In many of the works of the civil engineer this course of procedure is not possible, but it should be approximated to as nearly as may be, and where experiment cannot be had recourse to, extended experience must serve the turn. Experience is a knowledge of facts, and to the accumulation of facts the efforts of the civil engineer should be unremittingly directed, for every year produces a fresh crop of them.

A general acquaintance with the principles of natural philosophy is indispensable to the engineer: he must be acquainted with the properties of matter, the laws of motion and forces, the resolution and composition of motion and forces, the laws of heat, the leading truths of geology, the principles of hydrostatics, and other subjects of a similar nature. He should be able to compute the strain upon different parts of structures and machines, in order that the quantity of iron, woodwork, or stone employed, may be apportioned thereto; and he should have a sound and familiar acquaintance with the strength of materials. Geometry is of more importance than algebra for most purposes, and in shaping the stones for bridges, skew arches, domes, niches and other similar works, it becomes of especial service. An acquaintance with machines is very desirable, and on this basis a solid structure of proficiency may generally be reared; for to the sound mechanical engineer other engineering tasks may generally be safely confided. A knowledge of the French, Italian, and German languages will be found useful, as it will facilitate reference to continental engineering authors, and a large collection of valuable facts may be made from these sources.

But the most satisfactory way of determining the qualifications necessary for the civil engineer, perhaps, is to take a few works in various departments of engineering, and then to inquire what the qualifications are which are necessary to their successful execution. This method was pursued some years ago by Colonel Jackson, in an article contributed by him to the *Architect, Engineer and Surveyor*, since incorporated with this journal; and we believe we cannot do better than recapitulate a few of his statements:—

"Supposing," says Colonel Jackson, "that a canal is to be constructed, whether for the general transit of goods of all kinds, or for bringing to market coals, stone, grain, or other natural productions of the country, or the produce of some important manufactories situated along the line &c., the first thing to be considered is the capability of the country for the establishment of the canal; this of course requires a knowledge of it, and many considerations must be present to the mind of the engineer, when he examines it for the purpose of canalization. If satisfied that a canal may be made, it is then necessary to determine the line of direction between the several places through which it must pass. This line must be the most direct and the most horizontal possible, in order to avoid both expense and unnecessary delay. The highest parts must be so situated as to command a constant supply of the necessary quantity of water, and the lowest must be secured against a dangerous influx. Perhaps the reservoir or the tributaries, whence the supply of water is to be obtained, are situated at a distance; perhaps a reservoir is to be formed, the waters of surface drainage are to be carried off. All this, and similar considerations, must be taken into account, and before they can be acted upon, an extensive set of levels must be obtained. Supposing the levels taken, the nature of the soil on the proposed line is to be examined; some portions of it may be rock, or clay, or sand, or bog; the rock may be of a nature more or less difficult to excavate, and as it is always an expensive operation, the cheapest and most expeditious of the known modes must be employed, or a new one devised. The rock may be of such a nature that its debris may be of no other use than for filling up, or it may afford an excellent building or facing material, or be othewise useful in the arts, if properly quarried for the purpose. But, independent of this, the stratification of the mass, particularly if the line should happen to follow the *anticlinal* axis, may be such, that so much water will be lost by infiltration as to render puddling necessary, a difficult operation in such cases; whereas, if the line should follow the *synclinal* axis of the strata, the superabundance of drainage into that part of the canal may be very inconvenient, and render it necessary to carry off the surplus water by the construction of out-fall drains at the first convenient place. Should the soil be clay or loam, it may be useful for the making of bricks, or quite unfit for this purpose, as when it contains lime: marl may be valuable as a manure for the surrounding country, and good gravel is always valuable. Should the soil be sand, the difficulty of keeping the channel clear is very great, independent of the loss of water by infiltration; and if, therefore, the inconvenience cannot be got rid of by altering the direction, it must be remedied by puddling, or other means. A swampy soil must first be drained; and from the very fact of the waters accumulating there, it is probably low land as regards the neighbouring country, and therefore not easily drained, unless perhaps by boring—an economical method, but which requires much judgment. Should the soil be peat, allowance must be made for, and precautions taken against the rising of the bottom of the excavation, and the collapsing of the sides; and, further, a solid towing path must be constructed. The difficulties, then, which the nature of the soil presents along the proposed line, may be so great as to cause it to be changed, or those difficulties must be overcome by a perfect knowledge of their nature, and by practical skill, or happy contrivance. The exact line at length fixed upon, and the dimensions of the canal as to depth and breath of water also determined by the nature and extent of the transfers to be effected by its means, and the necessary supply of water estimated, and secured (the latter implying a correct knowledge of the levels of the several water courses, and natural and artificial reservoirs, with the quantity of water they respectively furnish at different seasons, together with the loss by evaporation and infiltration, both of the supplying waters, and those of the canal itself,) how much yet remains to be done in the planning of the details. Rising grounds are to be cut through in one place, valleys filled up in another, or crossed by aqueducts, the canals are to be carried over hills by means of locks, or made to pass through them by tunnels. In one place, the banks are to be vertical, or but slightly inclined, in another, very sloping; in one place, catch drains are to be made to secure the banks of the canal from the effects of the erosion of hills resulting from surface drainage of higher levels, and the water thus collected brought into the canal, or carried off under it by culverts. In one place, weirs are to be constructed, in another, safety-gates; here the canal is to be connected with a river, there with a lake or an arm of the sea; here bridges are required to carry the road over the canal, there the road is to pass under the canal; in one place, the bank is to be sodded, in another paved; here the direction of the road crossing the line is to be changed, or one made where there was none before; here locks are to be constructed, or their substitutes, inclined planes; there, wharfs, with cranes, and sheds, and store-houses, or basins and yards for the construction and repair of the boats; in one part of the line dead fences or parapet walls are required, in another, quickset hedges are to be planted, &c. All this determined and laid down, and the plans drawn, the contracts are to be made, the mode of working defined, and the execution of the whole to be superintended.

"From this very rapid sketch sufficient may be gleaned to show that there is not a single one of the positive and physical sciences which is not essential to the engineer. But his labours are by no means confined to the construction of canals or artificial water courses. He is called upon to drain marshes, to reclaim lands from the sea, by warping or otherwise, or to protect the former from the encroachments of the latter by sea walls, by spurs, or other means; to rescue land from the devastation caused by torrents, and by the periodical overflowings of rivers, to construct reservoirs, and bring streams into them; to raise the water of a river in some parts of its course to a higher level, and keep it there by permanent walls, or embankments, or weirs, or regulate its height by sluices or gates; to draw off water by cuts for the purposes of irrigation, for the service of mills, &c., to render rivers navigable by deepening their beds, by the removal of such obstacles as rocks, shoals, and banks, and to prevent the renewed formation of the latter by securing the river from fresh influx of shingle and silt, and other detrital matter, or by forcing the river to scour its own bed, and keep it clean, to secure the banks of a stream from the erosion of the current, so as its present direction may not change, or to effect a change in such direction by a new channel; he has to draw water from mines, and carry it off, to bring water for the supply of cities by conduits or aqueducts, or to procure it by the boring of Artesian wells; he is called upon to improve or form harbours, by the construction of jetties, and piers, and breakwaters; to excavate docks and build quays; to erect lighthouses, some of them in most critical positions, as on tide-covered rocks, and on sandy shoals; he is called upon to choose the most eligible situation for new towns and cities, and to plan them when the site is fixed upon; to him the inhabitants of cities subject to inundations look for the means of securing their lives and properties; to him is confided the tracing of roads of every description, and their construction, from the small byway to the long and perfect high road to be carried over deep valleys, rivers, and marshes, along the sides of precipices, through rocks, and over hills; he has to trace and lay down railroads, to construct bridges of all kinds, and in all kinds of situations, here of wood, there of brick, stone, or iron; in one case resting his arches on piers deep founded under water, in another, abutting them against the rocky sides of some precipitous ravine, or suspending his bridge by chains or rods, &c. &c. Indeed, the attributions of the civil engineer, even in the direct and legitimate line of his profession are innumerable. Independent of this, however, there is a multitude of objects which, though not strictly belonging to the science of engineering, are so intimately connected with it, that, unless the engineer has a very considerable acquaintance with them, he cannot assure to the public the full value of his profession, and is in danger of doing as much mischief in one way as he does good in another, of which, unfortunately, there have been but too many instances. If the attributes of the civil engineer are numerous and various, so is each of the several kinds of works which we have rapidly indicated exceedingly extensive in itself, there being hardly one of them on which voluminous treatises have not been written; and, if to these we add general treatises on engineering, and particular treatises as on bricks, mortars and cements, carpentry, &c., an extensive list of special publications on particular works, besides those books which treat of the sciences on which all engineering labours are based, we can readily conceive what extent of varied knowledge is required for the exercise of the profession of the civil engineer."

But the question next arises how is all this information to be obtained. Upon this subject Colonel Jackson remarks as follows: "The modes of excavating in different soils; the wetting of the spade in digging clay; the wetting of bricks, or using them dry, according to circumstances; the distinguishing, by close inspection of stones apparently uniform in texture, the way in which they lay in their natural bed, so as to place them in the same or some other direction in masonry, as the case may require; the doseing and mixing of the ingredients of mortars and cements in conformity with the quality of the lime; the judging of this quality by simple inspection before or after burning, as also of the quality of all rough materials, which can hardly be accomplished but by constantly having them before our eyes; the judging of the extent and settlement of various kinds of masonry under different seasonal circumstances, and according to the rapidity with which a wall is carried up; the settling of mounds of earth also, under various circumstances, &c. &c.—Such and numberless other details, all more or less important, must be learnt by what is termed practice, or by actual and repeated observation. The most trifling are important. By the wetting of the spade in digging stiff clay, twice as much work may be done in the same time and with twice as much ease as could be effected without this simple precaution. The schoolboy, ignorant of the fact that to cut caoutchouc the knife must be wetted, hacks, and saws, and tugs, with little or no effect, while a more knowing one takes the penknife, wets the blade in his mouth, and the separation is formed with ease, speed, and neatly; so is it in the minor operations of the engineer's art: and, as the perfection of the whole depends on the perfection of the parts, the practice of details is essential to the engineer. A dam was constructed in which the mortar used was mixed with unwashed sea-sand, efflorescence soon took place, adhesion was destroyed, the dam fell, and great was the devastation and loss sustained.

"The general preliminary operations to which we have alluded, and which are applicable alike to different works, are such as surveying and levelling. Here theory and practice must go hand in hand, and, indeed, if either can do without the other, it is practice which is the more essential. Many a man can very accurately survey a portion of land by dint of practice who knows little of theoretical geometry, of trigonometrical calculations, or the complicated problems of the higher branches of geodesy, while a first-rate mathematician, unaccustomed to the use of surveying instruments, and unpractised in the actual labour of surveying, would make but a sorry surveyor. The same may be said of levelling, an operation which when carried over an extensive space is often intricate, and always requires that kind of skill which long practice can alone give. The same is also the case with many other preliminary operations, such as the general inspection of the ground, by which its capabilities may be roughly estimated, an operation which requires so much practice that what may be termed the *engineering eye* can no more be formed without it, than the military eye of the general, so indispensable to the success of his tactics.

"It may appear to some that we have too limited an idea of the extent to which practice can be useful to the engineer; this, however, is far from being the case, for, as we have said, there are details much too numerous to be specified, in which practice is not only useful but essential, and there are many more general preliminary operations in which an engineer becomes perfect by practice than we have enumerated.

"It must also be observed that there is a confusion of terms, and what by many is termed *practice* should be called *experience*, for that is what they mean. Now no one can deny that the more experience an engineer has in his profession, the more competent he will be to execute any great works which may be confided to him. Practice is only a part, though an essential part of experience; but experience embraces a much wider field, it includes observation and study. Thus, in the course of some great work, the subordinate engineer may be practically acquainted with very little or no part of it; but, by dint of observation, he learns how the various operations are performed, and he notes the advantages or disadvantages of the methods employed, their success or failure, and the knowledge thus acquired is treasured up in his memory or his note book to serve him on a future occasion: add to this, that his attention being particularly called to certain operations, he reads and studies the subject, and thus, by combining theory with observation of the practice with others, he learns many things which he has never practised himself, and which no theory alone can teach him so well. Now, as this applies to every department of engineering, it must be acknowledged that a certain time employed at or upon the work themselves is indispensable in engineering education, if not in order to practice, at least to see the actual results of practice, the modes which long practice in different kinds of work have pointed out as the best. Some operations certainly may be learned at other places than at the works, but they are few in number; for the greater part, owing to their magnitude, can be learned only at the works. Thus experience is acquired, and none but experienced engineers should be entrusted with great national works. So much then for what is usually termed practice, by which experience is meant.

"What now is *theory?* This term, like the term *practice*, of which we have just spoken, is much misunderstood; but, the mistake is more excusable, as the word has, in reality, a vague signification. Thus theory often means what is merely speculative or hypothetical, but it also means the principles of an art or science, the positive and methodized results of experience. That theory, in the sense of speculation or hypothesis, is of little use to the civil engineer will readily be granted; nay, more, we are of opinion that it is detrimental. Systems when not founded on experience, or when based on partial and imperfect experience, are often found totally erroneous when their application is attempted, and such attempts have too often proved of most serious consequence to all concerned. But theory, in the sense of the methodized results of experience, not only can never mislead, but is of the highest importance.

"The theory of drainage, for instance, is founded upon that general law of nature, by which water ever flows, when unobstructed, to the lowest level, and consists of the application of this law to particular cases, as resulting from much practice and long experience in clearing land from their superabundant fluid. There are various ways of operating according to the extent of the land to be drained, the nature of its soil, the causes which occasion the water being collected on it, and the direction and nature of the slopes by which it may be carried off. Now from time immemorial drainage has been practised, and under every complication of circumstances in a great variety of ways, and with more or less success. The result of all this experience is consigned as matter of fact, and composes the theory of drainage. Now, as no individual, particularly in the commencement of his career, can have had practice in every kind of drainage, or even have seen it performed under the various circumstances that present themselves, it cannot be denied that he who has acquired a perfect knowledge of the theory of drainage is much more likely to proceed, in any operation of the kind that may be confided to him, upon sure and unerring principles, than another who has no such knowledge. The same may be said of the theory of bridge building, of embanking, of road making, &c., so that the engineer who has theoretical knowledge is a more efficient engineer than he who has it not. We have said that practice or experience is necessary; theory is so likewise; indeed, the simplest practical operations performed by the mason, the carpenter, the excavator, &c., are but the applications of theory. Regarding theory and practice, the natural order is this, first, blind experiments, then the practice or frequent repetition of those modes of operating found by experience to be the best, and, ultimately, the consignment and methodical arrangement of these modes for the use of future practitioners, which last is theory.

"Experience can nowhere be acquired but at the works; theoretical knowledge may be obtained in two ways, either by private study or public tuition. Private study has certainly this great advantage over every other, that, whatever is learnt in that way is generally well retained, and the reason is obvious; private study argues an ardent desire to learn, and that which we do willingly we are most likely to succeed in. Besides, the want of assistance compels us to turn a subject over and over, in order to understand it properly, and this exercise imprints it forcibly upon the mind. On the other hand, there are many subjects which cannot be mastered without assistance, and with which, therefore, private study affords us but a slight acquaintance; neither does it hardly ever happen that a young man, so circumstanced as to be under the necessity of teaching himself is in possession of those various adjuncts, a well chosen professional library, plans, models, &c. which are so essential to a good engineering education; so that the progress of the self-taught is comparatively slow, and his knowledge necessarily very imperfect in many points, till it is improved by experience. It is true that a few of our greatest engineers have been self-taught, but the number of such has been very limited indeed; and they were men of extraordinary genius. The greater number have all been taught more or less, and those men who could make such progress by dint of their own unaided exertions, or with only partial tuition, would, with the same ardour for knowledge, and the same indefatigable study, have derived the greatest benefit from a regular professional education, and been earlier fitted for their important duties. We come now to public tuition. But first let us enumerate what are the sciences necessary to the civil engineer. We have already said that there is not one of the positive and physical sciences with which he should not have some acquaintance, and that he must be master of many. Mathematics and mechanics, in all their branches, pure and applied, rectilinear and spherical trigonometry and levelling, constructive and analytical geometry, descriptive geometry or projection, civil architecture and general construction, drawing in all its branches, land and water transport, are all absolutely essential, and to which should be added, as almost equally so, geology, mineralogy, and mining, with certain parts of physics and chemistry, particularly that branch of the latter which treats of metallurgy, naval architecture, and a general acquaintance with military architecture, the laws of property as connected with the projects of the civil engineer, and certain branches of statistics. As for languages they may be dispensed with, but would be eminently useful. French is not only necessary as one of the elements of a liberal education, but as particularly useful to the engineer, by reason of the many admirable scientific treatises on the various departments of engineering, and its collateral sciences, which are written in that language. The German is also useful for mining details, physical geography and general science. In the Italian language will be found some of the ablest treatises on the management of running waters; for the devastations to which Italy is subject from the constant overflowing of its torrential streams had early drawn the attention of the Italian engineers to this important subject. An acquaintance with the Dutch language would open to the engineer a mine of interesting information on embanking and draining."

Respecting the department of general construction, Colonel Jackson remarks:—"This object embraces so much, that what in engineering education is called the course of general construction, might as well be termed a course of engineering. It is divided into two parts: in one, the objects are of a general nature; in the other, they are of a specific character. The first part includes generally—

"First,—The knowledge of all the materials used in engineering labour of every kind; and, of the powers employed in the use of these.

"Second,—The details of execution of any projected work; the preliminary labours; the laying out of the work; its actual execution and the responsibility of supervision and success. The material with which the engineer has to deal are the several kinds of earth, stones, wood and metals, bricks, tiles, mortars and cements, cordage of all kinds, paints, varnishes, &c. Regarding every one of these, he must learn many particulars, such as their solidity, strength, specific gravity, their degree of durability under different circumstances, their scarcity or abundance, their price at the market, or place of production, the expense of transport by different means, and the mode of estimating it, &c. The powers employed are men, animals, wind, water, or steam, acting directly, or by means of machines. Of these several forces, the engineer must know the extent and respective advantages in different circumstances; as also the amount and value of the labour that can be performed by each, in a given time, with its price, &c. The general preliminary labours consist in a matured consideration of the nature and objects of any proposed undertaking, in order to determine, first, the possibility of its execution, and whether or not the advantages are such as to warrant the presumed outlay; secondly, the inspection of the scene of operation, the necessary surveys, levelling, sounding of dead water, and calculation of its quantity, as the cubical contents of lakes, reservoirs, and ponds, estimation of currents and of the quantity of water which passes any place in a given time, borings, experimental essays, as on the permeability of soils, &c., with the price of such labours; measurements, drawings of all kinds, models, estimates general and detailed, memoirs, &c. The laying out of the works comprises their distribution in such manner that the whole may be executed in the best, the speediest, and the most economical manner, the establishment of the magazines or storehouse, the workshops and the machines, the supply of materials, &c. The actual execution includes a perfect knowledge of all kinds of construction, properly so called; such as embanking and excavating, in all their variety of circumstances; foundations of all kinds, and in every kind of soil; caisoons, pile-driving &c., scaffolding, centering, raising of heavy masses, &c., &c.; every one of which objects alone embraces a multitude of considerations and details of execution. The responsibility includes the direction of the several agents, the police of the works, the health and safety of the workmen, the keeping of the books and accounts and the general surveillance.

"From these objects, which are of a general nature, let us pass to to those which are special. These are so numerous that their mere terminology would occupy pages. We must therefore confine ourselves to a few particular heads. Such are roads of all kinds in plains, and in mountainous countries; the modes of constructing paved ways, and employing regular paving stones, or boulders; macadamized roads, and such as are of gravel or flints, or other material. Wooden roads, whether of trees laid crossways, and called corduroy roads, or of planks, or of branches and fascines, or of regularly cut and laid blocks; common earthen roads, railroads, and roads of mixed character; their side plantations, hedges, ditches, footways, &c. Bridges of all kinds, whether permanent, such as aqueducts and viaducts, wooden bridges, stone and brick bridges, cast or wrought iron bridges, suspension bridges, &c., or moveable, as pontoon bridges, drawbridges, sliding and turning bridges, and flying bridges. Tunnels, and other subterranean galleries. In connection with internal navigation, which may be effected either by natural or artificial water-courses, the following objects of special instruction must be learnt. The tracing of channels, and laying down of buoys and beacons of various kinds, at the mouths of navigable rivers, the establishment of towing-paths, &c. Regarding the rivers themselves, the labours to be executed in such cases as when the rapidity of the stream is too great, or when there is an insufficient depth or quantity of water; or where cataracts, rapids, interrupting rocks and banks are met with; the necessity of keeping the river in its channel, of directing its course, protecting its banks, &c. The establishment of gates, dams, weirs, &c., bringing water into the river, or drawing some of it off, &c. The tracing and construction of canals, and every thing connected with them, embracing most extensive and various details of construction. Connected with external or coasting navigation, special construction comprises the forming of ports and harbours of every kind, and in very different circumstances, with their sea walls, piers, and jetties, quays, basins, docks and yards, light and signal houses, batteries, &c. The deepening of ports and channels by various means, as dragging, scouring, &c. For towns and cities, the planning of the same after the site has been chosen, so as to secure all the advantages of easy communication, good circulation of air, and surface drainage, sewerage, supply of water, &c."

We are not of opinion that an engineer should be expected to turn indifferently to any of the numerous subjects that have here been mentioned. Railway engineers usually know but little of mills, hydraulics, and the construction of ships, and mechanical engineers are seldom practically conversant with earthworks and construction. Nevertheless we think it desirable that a general survey should be obtained of the broad field of engineering science by every one aspiring to cultivate any particular department of it; and there will be fewer mistakes committed and less ingenuity wasted in the proportion in which engineers are instructed in the first principles of their profession. The development of the inventive faculty, however, will be to some extent discouraged; precedent will assume a greater authority, and improvement will not advance with more rapid strides. But if a large supply of engineers of respectable attainments be needed, a systematic course of instruction in the general principles of their art will best produce them. Such a course of instruction was that contemplated by the founders of the College for Civil Engineers, which was intended to do for England what the Polytechnic School has done for France; but after various phases of mismanagement the College for Civil Engineers has dwindled to the condition of a mere private school, and appears to be capable of accomplishing nothing more for its pupils than is achieved by the engineering classes now formed in the various colleges throughout the country. Everything valuable in the original institution of the College for Civil Engineers is due to Colonel Jackson, and had be continued to direct the affairs of the college, there is every probability that its reputation would have become answerable to the excellence of the design; but, as was mentioned in the first number of the *Artizan* in our remarks upon this subject, the chicane and corruption which had gained an introduction into the directory, could not be reconciled in their sinuous operations with the fastidious honour and perfect ingenuousness of Colonel Jackson's procedures, and finding that he was thwarted from other motives than a regard to the prosperity of the college, he resigned his office of Resident Director. From that time the college has continued to decline: it first became ridiculous, and afterwards earned a severer reprehension; and now we believe it has settled into the condition of a tolerably respectable academy. It has fallen from its high estate; it has broken its promises to the public, as well as disappointed the hopes of the pupils it had entrapped into its communion; and what defence, we should wish to know, has the Duke of Buccleuch and the various noble personages whose names appear as baits in the prospectus, to adduce in extenuation of the deception? There is not in England a more benevolent man than the Duke of Buccleuch, and it cannot be doubted that he assumed the office of President of the College for Civil Engineers from motives of pure philanthropy. In the same honourable spirit the greater number of his coadjutors probably lent their aid; yet we think their conduct reprehensible from its supineness, for they suffered a faction in the council, who made up by activity for other wants, to rule the institution for their own ends, which were neither magnanimous nor disinterested. It was with these persons Colonel Jackson had to contend, and in suffering him to be overborne, the Duke of Buccleuch and the rest permitted chicane to achieve a victory,—to so strengthen itself, and so to weaken the opposing element, that the ruin of the institution has been the result.

The association, which afterwards became the College for Civil Engineers, was first proposed by Mr. H. Horneman, but in a preposterous and impracticable form. The following is the original prospectus :—

"THE GREAT NATIONAL INSTITUTION OF ENGINEERS AND MECHANICS.

"The principal and leading object of this truly National Institution is to instruct youth of all classes in the theory and practice of the important art of Mechanics generally, more particularly the construction of the locomotive, marine, and stationary engines. The number of pupils will be limited to 2,000, and the sons of mechanics of all descriptions may be bound as apprentices to the establishment, on a certain and moderate scale of charges now in preparation*; and this will not equal one half of the amount paid by a person apprenticing his son to a trade. During the term of apprenticeship the students, or apprentices, of this class, will be found in board. They may be clothed if required, for which an extra quarterly charge will be made. The system of education laid down is simple and most expeditious. The masters will consist of persons of known and undoubted reputation, and in the choice of them the greatest care and vigilance will be used. For the furtherance of this object it will be necessary to raise a capital of £100,000 in 5000 shares, of £20 each, with a deposit of £3 per share, one half of which will probably not be required. Lectures will be given and mechanical experiments used. The College will be divided into two great classes, the premiums in which will be regulated according to the various branches in which pupils will be instructed; and those who pay the higher premiums will not be found with board, &c. in the establishment, but will attend at a certain hour in the morning, and be allowed proper time for meals, similar to a large public school.† The Great National Institution of Engineers and Mechanics will be under the protection and patronage of many enlightened noblemen, scientific gentlemen from Oxford and Cambridge Universities, whose prominent study has been mathematics, &c. and the talented practical man—from these the board of management will be formed, which when completed, will be laid before the public, in the form of a prospectus. It is further proposed to establish the Institution in Dublin and Edinburgh, on the same footing as in London, and thus carry out its national character. Persons capable of teaching the practical part of mechanics—particularly that relating to the locomotive, the marine, and stationary engine, must state in writing to the secretary their qualifications, if they have been versed in the instruction of youth, where they have been brought up and served their apprenticeship, their age, and the nature of their former occupations. It is necessary that parties applying, should possess a correct and sound knowledge of smith's work. It was the original intention of this Institution, to have erected in the vicinity of the metropolis, a suitable building, to establish and carry on this great and important work, but eligible premises have been seen which can be obtained at a fair price, capable of great improvement, and suitable in every respect for the required purposes; but should the negociations not be favourably concluded, the promoters of the Institution propose to purchase sufficient freehold ground to build on. All communications must be post free, and addressed to Mr. H. Horneman, at the Temporary Offices, 23, Finch-lane, Cornhill, London.—*May* 5*th*, 1838."

One of these prospectuses was sent by Mr. Horneman to Colonel Jackson; and in Colonel Jackson's reply now lying before us, he raises numerous objections to the scheme, and declines to become a party to it. He first objects to the name; the Institution, he says, has no right to the term 'National', nor is an institution of engineers a proper designation, inasmuch as it is properly only an institution of mechanics. Colonel Jackson next asks what is to become of the 600 apprentices yearly sent adrift upon the world, in addition to those bound to masters in the usual way; and he questions whether the law would recognize such apprenticeships. After various other objections, Colonel Jackson concludes as follows :—

"Finally, it is said in a note 'enormous funds will eventually be formed.' Now considering that the apprentices are not to pay the one half of what is usually paid by a person apprenticing his son—that an immense edifice is to be bought or improved, or ground purchased and a building erected; that masters and servants are to be paid, and that a certain number of youths, say half the total number, or 1,000, are to be fed, lighted and warmed; that instruments and models of course are to be procured, &c.; whence, I would ask, are the enormous funds to proceed? and if they come, to what are they to be applied? If as a premium or profit to shareholders, the institution loses all its dignity, and dwindles down into a vile mercenary speculation, clothed under a specious mask—a concern to which no man of honour would lend his name. But if these enormous funds are to be employed in furthering the grand object of the general education of the working classes, as it is but fair to presume, then this should have beeen specified. Thus upon the whole I confess, sir, I can gather so little from the printed paper you have been pleased to send me, and that little seems to me so inconceivably vague and unsatisfactory, that I must beg to be excused from taking any part in the projected institution, at least until it be better digested, and its objects and plans more maturely detailed."

This letter was dated on the 29th of May, and some time afterwards, Mr. Horneman sent Colonel Jackson an amended prospectus, accompanied by a letter, acknowledging the weight of his objections and adding, that he was desirous of profiting by Colonel Jackson's further consideration of the subject. This second circular was as follows :—

"THE BRITISH INSTITUTION FOR CIVIL ENGINEERS.

"Patron, ——; President, ——; Vice-Presidents, ——; Trustees, ——; Provisional Committee—Colonel Landmann, C.E.; Capt. Burt, H.C.S.; Capt. Andrews, H.C.S.; Geo. Walter, Esq.; John Stanford, Esq.; Capt. Byng Hall. Professors and Lecturers, ——; Standing Committee, ——; Directing Engineer, John Stanford, Esq., C.E.; Solicitors, ——; Bankers, ——; Secretary, Mr. H. A. Horneman. Capital, £100,000, in 5,000 shares, of £20 each; deposit, £1 per share. The necessity of a more general and perfect knowledge of the principles of mechanics and the management of steam engines is evinced by their vastly extending application, and fully demonstrated by the numerous and awful accidents which almost daily occur in different parts of the globe, to the sacrifice of innumerable lives through the ignorance of the conductors, many lamentable recent instances of which have occurred even on the river Thames, independent of those on the various railroads. This institution is established to give the rising generation theoretical and practical instruction on the plan of a large academy and manufactory combined; to be conducted by skilful scientific men, possessing practical attainments, and to afford experiments on a grand scale, whereby the application of steam power may be fully developed to the students, and particularly the construction of locomotive, marine, and stationary engines. The college will be divided into classes for the study of mathematics, as applicable especially to mechanics, the construction of engines, hydrostatics, and the power of expansive forces; and students or articled pupils will be educated in every science requisite to qualify them as engineers, the latter may be bound from three to five, or seven years, and a scale of charges will shortly be published. Forges and foundries will be established for the practical operations required to instruct the students in the essential knowledge of working in metals. The important objects of this institution merits the highest support, both British and *Foreign pupils being admitted on the plan of a Polytechnic school.* A system of rewards for the students or other individuals who may distinguish themselves by discovering methods of security against accidents, &c. from steam machinery, will be adopted, and a committee will be formed of scientific gentlemen of acknowledged ability and talent to award the same.

"The system of education will be simple and complete, under masters selected with the greatest caution from men of standing and experience. Extensive premises in a healthy situation contiguous to the metropolis, are in prospect, for carrying on the objects of the institution, and it is intended to form branch establishments in Edinburgh and Dublin in furtherance of its national character. The students on their competency being determined will have the advantage of an influential introduction to early employment. Courses of examination will be held periodically by the professors; the number of pupils will be limited, and the scale of charges so moderate as to afford the greatest facility to parents disposed to avail themselves of the advantages of this institution, and the nominations of shareholders will have the preference. With reference to prospective advantage it is only necessary to remark that, independent of returns from the fabrication of machinery, &c., the premium for the admission of students, together with monies derivable from visitors at periodical lectures, and on the exhibition days of experiment, present a fair prospect of a liberal return to the subscribers. A museum for the deposit of models, engines, &c., for the instruction of the pupils, will be formed; and inventors of improvements, however humble, will be encouraged to deposit the fruits of their ingenuity and labour in this institution, with a view to perfect the same, under adequate guarantees. The property will be held by trustees, to be selected at a general meeting of the proprietors, and the terms and management will be regulated by deed, until a charter or Act of Parliament be obtained. The capital of the company to be 100,000*l*., in 5,000 shares, of 20*l*. each. The bankers of the institution have instructions to receive the deposits, of 1*l*. per share, until the 1st of August next, and to grant receipts for the same; after which, due notice will be given, by advertisement, to the holders, for exchanging them for scrip, signed by three directors, and the names and numbers will then be registered in the books of the institution; application may also be made by letter, (post paid) to the committee, or secretary, for shares, which will be granted, upon such application proving satisfactory. No call shall exceed 3*l*. per share; nor shall less than three months elapse between each call. No shareholder will be held liable for more than the amount of his shares; and none, individually, to pay upon or hold more than five.

"(Signed) J. A. Chairman."

To this communication Colonel Jackson sent the following reply :—

15th August, 1838.

"I have to acknowledge the receipt of a second circular from you, and of

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* The scale of charges now preparing are calculated for quarterly payments, which will be a great accommodation to persons in moderate circumstances; and this will form an enormous fund eventually.

† The parents of the pupils of this class will have the option of paying the whole of the premium in one payment, or by the scale of quarterly charges; but if the latter method be chosen it must be in advance.

the letter by which it was accompanied; in that letter you are pleased to say, '*you are desirous of benefitting by my further consideration of the subject.*' I have not the presumption to think that my opinion can be of any weight in an object of such importance, and which must by this time have been considered under every point of view by a number of competent individuals. Nevertheless, I shall be very glad to see you any day this week that you can make it convenient to give me a call between 11 and 12 in the forenoon, more, I confess, from a desire of being made better acquainted with the nature of the proposed college, than from any idea of being in any way useful to the establishment. I am glad to see the name of the institution is changed, the present one is much more appropriate, though still far from being strictly correct. A school for scientific and practical engineering is much wanted, and as the government do not seem yet inclined to institute such a one, the task of its establishment must like every thing else with us devolve on individuals. But its organization and the means of raising the necessary funds seem to be attended with great difficulty, for very few, perhaps, will be disposed to advance money from principles of pure benevolence without hope of profit, and if pecuniary benefits are held out, the thinking part of the community will see nothing in the establishment but a pecuniary speculation reflecting, like a thousand others, little credit on those engaged in it, and destined like most of them to ultimate failure. The thing should bear disinterestedness on the very face of it. It must be conceived in the large and truly patriotic spirit of an establishment intended to supply an important desideratum, and confer a great and lasting benefit on the country. But of all this we can confer when we meet.

I am, Sir, &c."

Another prospectus was about this time drawn up, which, in the title the institution now assumes, approaches still nearer to Colonel Jackson's views; but Mr. Horneman's hand is still distinguishable in the prospectus, which carries vulgar scheming on its face. This prospectus runs as follows:—

"COLLEGE FOR CIVIL ENGINEERS; ALSO FOR INSTRUCTION IN THE MANAGEMENT OF MARINE AND OTHER ENGINES.

"Patron ———, Vice Patrons ———, Board of Management, Chairman ———, Treasurer, ———, Bankers, ———, Secretary, Mr. A. H. Horneman. Capital £100,000, in 5,000 shares of £20 each, Deposit £1 per share.

"*Introduction.*—At no period in the history of nations have there been so many and such gigantic public works constructed, as during the last ten or twelve years. The enormous amount of capital dragged forth into circulation through these means, has no doubt greatly tended to keep down that growing mass of pauperism which through the diminishing demand for manual labour and increasing population, was daily augmenting even to a frightful extent. The varied success which has attended those public works may, it cannot be doubted, be traced to the greater or less degree of talent and scientific knowledge of the civil engineer employed for carrying into effect the first, and perhaps crude ideas of an unprofessional projector. Thus, in some cases, the details of the object in view have been grossly imperfect, and in others, improvident expenditure in the execution has swallowed up an amount of capital quite inconsistent with profitable working: both tending to the natural result, a total failure. It is therefore, for the purpose of providing an economical and more perfect course of education for the youth of the present day, destined to follow the profession of civil engineering, that the institution above named has been devised: and it is anticipated, that many of the evils and failures, so ruinous to thousands, may, by this measure, be mitigated, if not altogether avoided. In addition to the first and prominent object—civil engineering—a second class is provided, for the instruction of persons in the management of steam engines of every description, and by which it cannot be doubted, that in a short period the numerous fatal and distressing accidents, now daily occurring, will be, at least, greatly diminished.

"*Address to the Public.*—No undertaking, however excellent, can possibly succeed unless sanctioned by popular opinion. It is therefore earnestly hoped that the patronage of the public will be accorded to an institution, the express objects of which are, to improve a service so necessary now to the prosperity of the country, and to guarantee the public against the fatal accidents which are of every day occurrence.

"*To Parents.*—An Institution which promises to afford instruction, far superior to anything to be derived from individual superintendence, at an expense moderate in comparison with premiums usually demanded, cannot fail, it is thought, to secure the good will of parents. The attention of parents is particularly directed to a very beneficial feature of the institution, the system of quarterly payments. An order having been passed by the Honourable Court of Directors of the East India Company, that no candidate shall in future be admitted into their naval service without being fully competent to the management of marine steam engines, this college holds out great inducements to parents to send their children to be thus instructed in engineering science. Parents desirous of availing themselves of the benefits of the institution, are requested to make an early application to the secretary, by letter, (post-paid) stating in what class they intend to place their children that their names may be forthwith registered. The students will be admitted in the order in which their names appear in the books, the nominees of subscribers having a preference as before stated. To subscribers, the premiums for the admissions of students, together with the monies derivable from visitors to the museum, at periodical lectures, and on the exhibition days of experiments, present a fair prospect of liberal returns."

Soon after this Mr. Horneman got into difficulties, and the developement of the scheme devolved upon Colonel Jackson, who became resident director. The undertaking now assumed a most promising aspect: the Duke of Buccleuch became president, the Duke of Richmond, Marquis of Tweeddale, Marquis of Sligo, Earl of Devon, and other persons of distinction became vice-presidents; Sir Frederick Pollock, Sir Peter Laurie, &c., trustees; and altogether the prospects of the college assumed the brightest complexion. Colonel Jackson laboured diligently in working out the details of the undertaking, and in settling the course of study to be pursued in the several classes. The scheme of study he fixed upon for each of the classes, after a diligent comparison of the practice abroad, and the advice of the most experienced instructors, is exhibited in the accompanying table:—

ORIGINAL SCHEME OF STUDY AND EMPLOYMENT OF TIME IN COLLEGE FOR CIVIL ENGINEERS.

SIXTH CLASS.

| HOURS. | MONDAY. | TUESDAY. | WEDNESDAY. | THURSDAY. | FRIDAY. | SATURDAY. |
|---|---|---|---|---|---|---|
| From rising till 8. ... | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. |
| 8 to half-past ... | BREAKFAST. | BREAKFAST | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. |
| Half-past 8 to 9 ... | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. |
| 9 to half-past 10 ... | Arithmetic by the Master and interrogations. | Algebra by the Master and interrogations. | Geometry by the Master, and interrogations. | Arithmetic by the Master and interrogations. | Algebra by the Master and interrogations. | Geometry by the Master and interrogations. |
| Half-past 10 to 12... | Study of the same with the Usher. | Study of the same with the Usher. | Study of the same with the Usher. | Study of the same with the Usher. | Study of the same with the Usher. | Study of the same with the Usher. |
| 12 to 1 | | | | | | |
| 1 to 2 | | | | | | |
| 2 to 3 | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. |
| 3 to half-past 4 ... | Architectural drawing | Universal Geography. | Machine drawing. | | History of England. | Calligraphy. |
| Half-past 4 to 6 ... | French language | Engl. gram. & language | German language. | | French language. | German language. |

FIFTH CLASS.

| HOURS. | MONDAY. | TUESDAY. | WEDNESDAY. | THURSDAY. | FRIDAY. | SATURDAY. |
|---|---|---|---|---|---|---|
| From rising till 8 | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. |
| 8 to half-past ... | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. |
| Half-past 8 to 9 ... | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. |
| 9 to half-past 10... | Architectural drawing. | Machine Drawing. | Ornamental Drawing. | Universal History. | German Language. | Elements of Mechanics by Professor. |
| Half-past 10 to 12 | French Language. | Geography of Gt. Britain | German Language. | French Language. | Topographical Drawing. | Study of the same with the Usher. |
| 12 to 1 | | | | | | |
| 1 to 2 | | | | | | |
| 2 to 3 | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. |
| 3 to half-past 4 ... | Elements of Mechanics by the Professor, and interrogations. | Algebra by the Master and interrogations. | Geometry by the Master and interrogations. | | Algebra by the Master and interrogations. | Geometry by the Master and interrogations. |
| Half-past 4 to 6 ... | Study of Mechanics with the Usher. | Study of the same with the Usher. | Study of the same with the Usher. | | Study of the same with the Usher. | Study of the same with the Usher. |

FOURTH CLASS.

| HOURS. | MONDAY. | TUESDAY. | WEDNESDAY. | THURSDAY. | FRIDAY. | SATURDAY. |
|---|---|---|---|---|---|---|
| From rising till 8 | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. | Free study. |
| 8 to half-past ... | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. |
| Half-past 8 to 9 ... | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. |
| 9 to half-past 10 | Former mathematical Studies recapitulated and concluded, & Analytical Geometry, and interrogations by the Professor. | Plane & Spherical Trigonometry & knowledge of Geodesical instruments. Theory of surveying and levelling. | French language and literature concluded. | Higher branches of Mechanics, illustrated by Models, &c. | Descriptive Geometry with shadows, and linear perspective. | Naval Architecture, professor particularly as applies to inland navigation. |
| Half-past 10 to 12 | Study of the same with the Usher. | Study of the same with the Usher. | Machine drawing. | The same studied with the Usher. | Drawings of * | The same, and drawings of, with the Monitor. * |
| 12 to 1 | | | | | | |
| 1 to 2 | | | | | | |
| 2 to 3 | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. |
| 3 to half-past 4 ... | Hydrography of the three Kingdoms. | Higher branches of Mechanics, illustrated by Models, &c. | Connection of Geography with Commerce and Industry. | | Ornamental drawing. | Architectural drawing. |
| Half-past 4 to 6 | Topographical drawing | The same studied with the Usher. | English Language and literature. | | German language and literature continued. | Civil Architecture, principles of, with the Professor. |

THIRD CLASS.

| HOURS. | MONDAY. | TUESDAY. | WEDNESDAY. | THURSDAY. | FRIDAY. | SATURDAY. |
|---|---|---|---|---|---|---|
| From rising till 8 | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. |
| 8 to half-past ... | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. |
| Half-past 8 to 9 ... | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. |
| 9 to half-past 10 ... | Lecture and examination of Foreign Engineering works. | General Mechanics concluded. | Materials of construction. Museum. | Descriptive Geometry applied. | Hydrography, Draining, Embanking Reservoirs &c | General construction Professor. |
| Half-past 10 to 12 | French and German. | The same studied with Usher. | Isometric perspective. | Drawing with Monitor * | The same with Monitor * | The same & drawings of * |
| 12 to 1 | | | | | | |
| 1 to 2 | | | | | | |
| 2 to 3 | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. |
| 3 to half-past 4 ... | Synthetical Statics & Integral and differential Calculus with the Professor and interrogations. | Civil Architecture, principles of, with the Professor | Coloured drawings of all kinds. | | Statistics of the British Empire. | Theory and operations of Mining. |
| Half past 4 to 6 ... | Study of the same with the Usher. | Study of and drawing with the Monitor * | Continued with the Monitor * | | Construction under water and Hydraulic and other cements. | Study of the same * |

SECOND CLASS.

| HOURS. | MONDAY. | TUESDAY. | WEDNESDAY. | THURSDAY. | FRIDAY. | SATURDAY. |
|---|---|---|---|---|---|---|
| From rising till 8. | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. |
| 8 to half-past. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. |
| Half-past 8 to 9. | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. |
| 9 to half-past 10 | Mechanics applied to Steam engines &c. | Hydrography, Draining, Embanking, Reservoirs &c. Internal navigation, &c. | Gen. Construction with Professor. | Elements of Physics, theory and practice. | Elements of Chemistry. | |
| half-past 10 to 12 | Practical demonstration. | The same with Monitor* | The same & drawings of* | The same.* | The same.* | |
| 12 to 1 | | | | | | |
| 1 to 2 | | | | | | |
| 2 to 3 | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. | DINNER. |
| 3 to half-past 4 | Mineralogy & Geology taught by Professor. | Mathematics, and Mathematical Geography, with the Professor, and interrogations. | Laws of Property, &c. as connected with projects of Civil Engineers. | | General Construction with Professor. | Translations of Engineering papers from the French and German writers. |
| Half-past 4 to 6 | Explanations in the same continued by Professor. | Study of same, with the Usher. | History and progress of Civil Engineering. | | Study of, with Monitor, and drawings.* | Aerial perspective, alone or * |

FIRST CLASS.

| HOURS. | MONDAY. | TUESDAY. | WEDNESDAY. | THURSDAY. | FRIDAY. | SATURDAY. |
|---|---|---|---|---|---|---|
| From rising till 8 | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. | Free Study. |
| 8 till half-past ... | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. | BREAKFAST. |
| Half-past 8 to 9 ... | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. | Recreation. |
| 9 to half-past 10 ... | General and particular Physics in their relations to the labours of the Engines. | Project for Inland Transport by land and water * | Mathematics recapitulated by the Professor and interrogations. | Application of Chemistry to Engineering purposes. | Mechanics recapitulated Theoretical and Practical. | Civil Architecture with the principles of lighting, warming & ventilating. |
| Half-past 10 to 12 | Study of * | The same alone * | Study of the same * | Study of * | | Study of with Monitor * |
| 12 to 1 | | | | | | |
| 1 to 2 | | | | | | |
| 2 to 3 | DINNER. | DINNER. | DINNER. | DINNER. | Free Study. | DINNER. |
| 3 to half-past 4 ... | Theory of Mining. | Mineralogy and Geology. | Composition of Memoirs. | | Grand competition drawg. | Free Study. |
| Half-past 4 to 6 ... | Study of the same * | Explanations in the same by the Professor. | The same continued * | | | General Construction * |

In the midst of these labours and successes, however jealousy was at work, and the probability appears to be, that one active and influential member of the council coveted the office of Rresident Director for himself, now that the prospects of the institution had become so encouraging. Colonel Jackson had taken no precautions against such sinister aims by introducing friends of his own into the council to defend his interests, and as the patrons of the institution kept very much aloof, the measures of the council were sometimes sullied by intrigue. Colonel Jackson expected that some fixity would be given to his situation, as is usual in such cases, but this was not done; and on the occasion of a letter having been written to the council by the resident director upon this subject, desiring a distinct understanding, in which mention was incidentally made of the college having been moulded in consonance with his views, the only answer returned was the following resolution :—

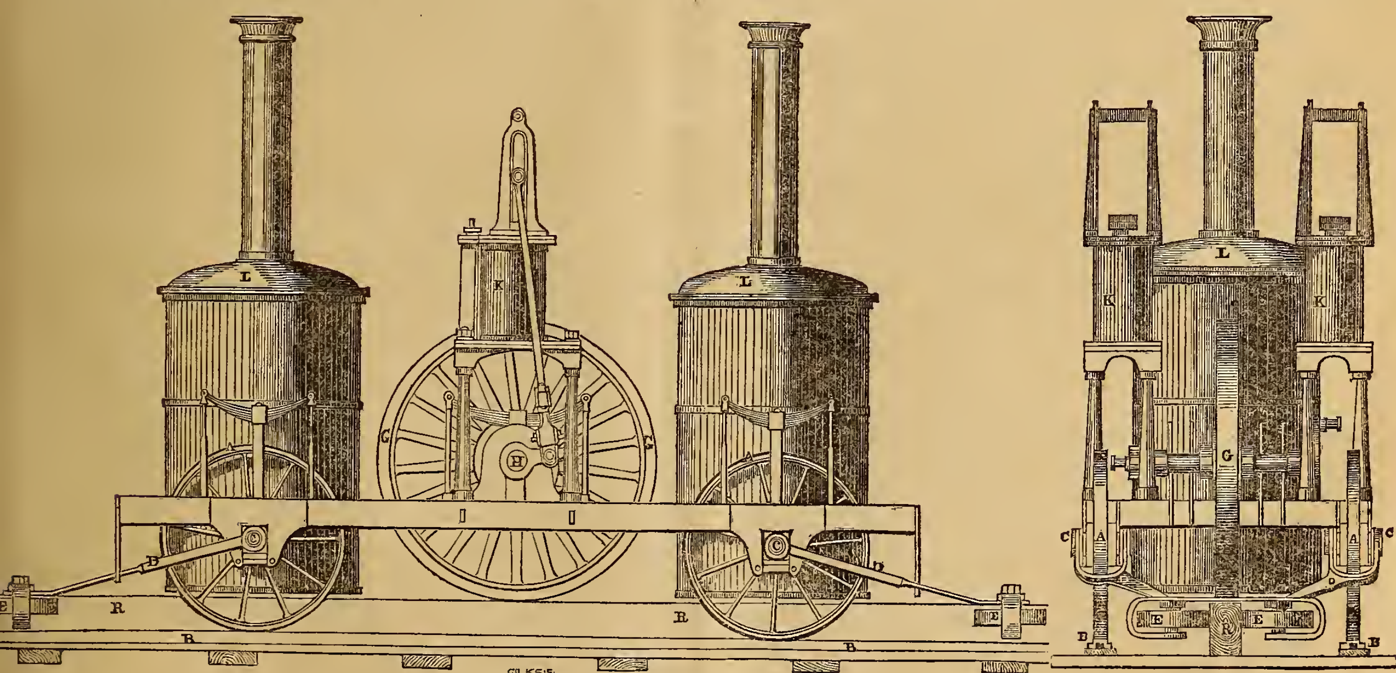
" Saturday, 25th January, 1840. At a special meeting of the Council of Administration of the College for Civil Engineers, holden this day, B. Westropp, Esq., in the chair, a letter from Colonel Jackson, the resident director, was read, whereupon in reference to the following clause in such letter, viz.: 'when in consequence of my suggestions the establishment originally projected was totally changed in its nature and objects;' it was resolved unanimously, that on reference to the minutes of proceedings on the 16th July, 1838, it appears that the great principles of the institution of the College for Civil Engineers are there laid down, and which period is prior to the co-operation of Colonel Jackson on the 17th August, 1838, and therefore the council unanimously refuse to admit the claim of Colonel Jackson as made in the claim of his letter above quoted."

Our readers have the materials before them to enable them to judge how far such a resolution was justified by the facts of the case. They have the original prospectus before them with Colonel Jackson's objections, the amended prospectus, with Colonel Jackson's proposed amendments upon it, until the scheme by the continuance of these excisory and supplementary processes, was gradually moulded into a reasonable form. At this stage Colonel Jackson took the scheme up and carried it to a successful result; for, during his administration, the College was in the best repute, and he cannot be held answerable for the subsequent declension. We hope, however, to see Colonel Jackson yet undertake the formation of an engineering college without the incumbrance of such coadjutors as Mr. Westropp: an engineering college is still as much wanted as ever, and Colonel Jackson has given the public adequate proofs of his ability to supply the deficiency.

## Art. VI.—PETTIT'S RAILWAY SYSTEM.

Mr. Pettit proposes to overcome the objections which attach to the ordinary methods of railway locomotion; First, by allowing every wheel in the train to revolve on a separate axle, and in its proper position; and, Secondly, by providing a wooden rail for the driving wheel, which will afford sufficient adhesion to enable the engine to ascend an incline, whilst iron rails are used for the carrying wheels, in order to reduce the friction of the load to the lowest possible amount; thus adapting the rails to the distinct purposes to which they are required. To carry out this system, the arrangement shewn in the accompanying views is proposed; but the peculiar position of the boilers and cylinders of the engine is not necessary to the invention. In the drawings, the same letters refer to both the side and end view; in the latter, one boiler is supposed to be removed. AAAA are the four carrying wheels, running on the iron rails BB, and fixed on their respective axles CCCC. The bearings of those carrying axles are fitted so as to allow them to swerve enough to keep the wheels true with the rails in passing round a curve: and they are guided in the right direction by the levers DDDD to the ends of which are fixed the guide wheels EEEE, running on each side of the centre rail R. These guide levers act exactly in the same manner as the shafts of a common four-wheeled carriage, and will lead the engine in the direction of the centre rail, which thus acts as a switch, and renders it impossible for the engine to run off the rails. On this account flanges to the wheels would not be necessary, although they might be adopted as an additional security in case of the guide levers or wheels breaking. G is the centre driving wheel, taking on to the central, wooden rail R, and fixed on the crank axle H, which may be driven as shewn in the drawing, or by any other convenient arrangement of the steam cylinders KK, &c. The plan shewn has the advantage of a straight axle, which is cheaper and safer than one with double cranks forged on. LL, are two cylindrical boilers with vertical tubes, through which the heated air passes to the chimney.

There is much judicious arrangement in this system of railway locomotion, and it is evidently the production of a practical mechanic; nevertheless, it is not exempt from imperfections, though time and experience may probably remove them. We fear that the use of a central driving wheel would be productive of a pitching and of an oscillating motion at high speeds; and though the oscillation might be prevented by a suitable arrangement of the guide wheels pressing laterally on the central rail, yet it is not so easy to see by what means the pitching could be effectually guarded against. This fault, however, is one which attaches equally to Stephenson's six-wheel locomotive, and to all the six-wheel engines at present constructed. Of the advantage of the boiler with upright tubes we are quite clear. The plan permits a large area of fire-grate, whereby a moderate draft suffices; and by making the tubes small, as they may be made when their collective area is doubled, the boiler, with upright tubes, need not be materially, if at all, higher than the steam dome of the existing locomotive. We have long been of opinion that a boiler of this kind must come into use: Mr. Pettit's arrangement is not, we conceive, the best that is possible, but it is an important step in the right direction, and deserves encouragement and praise.




SIDE VIEW. Scale, ½ inch to a foot. END VIEW.

## Art. VII.—TRAFALGAR-SQUARE AND ITS FOUNTAINS.

A great deal of needless vituperation has been lately poured out upon the fountains of Trafalgar-square, which have been denounced as of "intense ugliness.' In this sentence we cannot concur: we hold them to be puny and insufficient for the place, but so far from being intrinsically ugly, we consider that they would be reckoned handsome fountains in a conservatory or tea garden. Indeed their chief fault is one of dimensions, and it is a question how far that fault rests with the architect, for it is impossible to make imposing fountains where there is only a small quantity of water to spout; and the quantity of water available for the fountains appears to have been limited. In such a case it would have been better to make only one fountain, or even no fountain at all, if a creditable one could not be produced; but insignificance is not the same thing as deformity, and it argues but slender powers of discrimination to confound together under a common name such obviously different qualities. It is not an essential condition of beauty we suppose, that fountains should consist of pageants of sculpture where pagan gods and other august personages are crowded together to officiate as squirts. The most admired fountains are those in which water plays the chief part; the Trafalgar-square fountains have too little water, and therefore, they are unsatisfactory; but it appears to us an absurdity to hold that "intense ugliness" is a question of scale. Trafalgar-square, is called in the *Companion to the Almanac*, an ill-arranged spot, and not without reason, for instead of being fully considered at the outset, and being carried out according to one comprehensive scheme of improvement, the parts of the plan appear to have been thrown together at random, and it is consequently full of incongruities. That structure was suffered to be made a stumbling block from the first. While the line of buildings forming the east side of the square has been turned *askew* in order to be in the same direction as the portico of the church, the plan of the National Gallery has been in a great measure sacrificed to the whim of making that portico visible from Pall Mall East, as if, like a good many other things, the farther off it is viewed, to the greater advantage it is seen. In consequence of this hypothetical necessity, the architect of the Gallery was compelled to set back the general front of his building, and to squeeze it up upon a miserably narrow piece of ground; whereas, had he not been so controlled, he would have been able not only to bring the whole as far forward as the portico now advances, but could further have made the extremities of his façade to project in the same degree as they now recede. This would have rendered the gallery of double the capacity it now is—in fact, rather more so than at all less. Nor do we speak at random, for we have before us, besides a plan of the gallery, a large plan of Trafalgar-square and the buildings around it, taken from actual survey, and with the respective admeasurements figured upon it. Almost a glance at this last suffices to show the practicability—that *was* at least—of bringing forward the Gallery to the extent above-mentioned, without interfering with the line from Duncannon-street (on the south side of St. Martin's Church) to Pall Mall East, and even with some improvement to the latter street, inasmuch as it would have been of the same width throughout instead of being wider at the end adjoining the "square" than elsewhere. According to such plan, the portico of St. Martin's would not, indeed, have been actually within the boundary of the "square," but still distinctly visible from it, just as the cupola and east end of St. Paul's display themselves at the western extremity of Cheapside. Another advantage that would have attended the *exclusion* of St. Martin's, is, that the line of buildings on that side might have been carried parallel to the opposite one, and at a right angle to the Gallery, and putting all other circumstances together besides the advantage to the Gallery itself as regards its actual purpose, the square would have been less out of *square*,—and more compact and symmetrical.

The Nelson Monument—in itself an utter *nullity* as to design—one that might have been cut out from any book on the "Five Orders,"—has certainly not contributed at all to mend matters, it being put, not within, but just *without*, and on one side of the area which seems to have been expressly intended for its reception. The column and the fountains should change places: the former as the loftier object should occupy the centre of the enclosed space, and as subordinate ornamental accessories, the latter would with more propriety take up their position as its outworks. By such arrangement that balance and equipoise which are now altogether wanting, would have been secured. Still better would it have been had the Fountains been combined with and made to impart character to the Monument itself,—which, in such case, we hardly need observe, must have been less of an architectural platitude than a mere column which is not *monumentalized* by historical reliefs upon its shaft. Water spouting up and flowing around the base of an architectural mass surmounted by a colossal figure of Nelson, would have been equally significant and striking,—except, perhaps, that the small wits who compare the present fountains to dumb waiters, would have been merry on the subject of fresh water, protesting that it was fit only for fresh water sailors, and an insult to the hero of the Nile and Trafalgar.

If the *eccentric* position of the column renders the inclosed *area* too much of an *hors d'œuvre*, the effect of that inclosure is by no means so satisfactory, architecturally, as it might have been. Though intended to bring the whole space into something like symmetry, it serves to render all the more manifest the disagreeable obliquity of the line of buildings on the east side. The actual irregularity of the *place* is rendered doubly offensive by its contrast with the regularity aimed at by the area *inserted* into it. That the balustrated terrace and the massive pedestals for equestrian statues serve to set off the front of the "Gallery" as seen from the lower level of the *area*, is not to be denied; but that comparatively grandiose architectural embellishment renders the lateral ranges of buildings both east and west more unsatisfactory than ever. Even considered by itself the architecture of the inner area is far from unexceptionable. Architectural expression is in a great measure forfeited by the upper lines of the two side walls being made to slope downwards from north to south, in accordance with the declivity of the street or roadway on those sides of the square; instead of being carried horizontally, and parallel both to the level pavement of the area and the cornices and other lines of the adjacent buildings. In our opinion, and it is also that of the *Companion*,—this circumstance detracts very much from the general effect, that grandeur of composition which would have resulted from those two flanking walls being carried horizontally and made to to terminate in lofty masses corresponding with the *massifs* or pedestals at the other angles, being now missed, and the character of a decidedly marked architectural *parterre* as a foreground to the Gallery being lost. We feel that either too much or not enough has been done; accordingly feel dissatisfied; this feeling of dissatisfaction is heightened when we look at this vaunted "noblest site in Europe" in its general combination—if the term "combination" can be applied to what is so straggling and disjointed; not in consequence of its having grown up by degrees in a long series of years, but owing to faults which can adduce no such palliation. Even of the National Gallery, the exterior as well as the plan was injured by undue interference and dictation, the architect being compelled in deference to paltry economy, which mistakes meanness for thrift, to make use of the columns which had belonged to the portico of Carlton House for his own portico; instead of bringing in those columns in other parts of the façade, and employing a larger order for the centre of his composition, so as to obtain there a more elevated mass, as he had done in the London University. Thus restricted and thwarted, he endeavoured to give some appearance of adequate loftiness to the centre of the facade by hoisting the dome upon a disproportionably tall cylinder as its *sholobate*, so that instead of seeming at all *motived* by or connected with the main edifice it has the look of being another structure stuck accidentally upon it; The excrescence moreover led to the introduction of two others, the small octagonal turrets, or pepper boxes, which were no doubt erected to keep the dome in countenance. The dome, it must be admitted, is a decided failure; neither is the general façade what it might have been, or equal to what Mr. Wilkins would have made of it, had fair play been allowed him. Therefore let not the entire onus of failure be thrust upon him; let a due share of it fall upon those who were the controlling influences at the time—the stars that shone so unpropitiously at the birth of the edifice, and accomplished their destiny by blighting its renown.

## ART. VIII.—NOTES OF THE MONTH.

*Blowing-Off Apparatus for Tubular Boilers.*—A blowing-off apparatus has been applied to the boilers of the steamer *Tagus*, by Mr. Lamb, engineer of the Peninsular and Oriental Steam Company, of which we hear satisfactory accounts. It consists of a pipe leading from near the top of the water in the boiler, and to the mouth of the pipe a float and valve are attached, so that when the water level falls below the mouth of the pipe the valve is closed and the steam is unable to escape. The advantage of the arrangement lies in causing the water to be blown off from the surface of the water, which it cannot be doubted is the situation from which a blow-off-pipe should proceed. The particles of impalpable matter which, by their subsidence on the flues are converted into scale, are carried by the rising steam to the surface of the water, and if they can there be caught and discharged from the boiler, the formation of scale will be to a great extent prevented. This, we understand, is successfully done by Mr. Lamb's apparatus, of which we hope to be able to give a drawing on an early occasion.

*Equestrian Statue of the Duke of Wellington at Hyde Park.*—The equestrian statue of the Duke of Wellington intended to be erected upon the top of the triumphal arch at Constitution-hill is now completed, and arrangements are in progress for setting it in its place. In the mean time, however, a loud outcry has arisen against the appropriation of the arch to such a purpose, the plea being that any combination of the kind is in bad taste, and that the arch is not calculated to bear 30 tons of metal on the top of it. We must say we see no force in the first of these objections. A triumphal arch of any kind is an absurdity in the present age of the world; but supposing it built, is it criminal to make it subservient to a useful purpose? The arch, moreover, was intended in the first instance to be adorned with some kind of statuary work, and why may not the Duke of Wellington's statue be put there as well as the effigy of some heathen god or impossible animal? If the gate be too weak, that objection is of course entitled to its due weight; but four malleable iron pillars run through the stone work would support the 30 tons without danger or inconvenience. Sir Robert Peel on being questioned on the subject in the House of Commons, said that he thought the park front of the Horse Guards or Waterloo-place would have been a preferable situation, but that the permission to erect the statue over the arch leading from Hyde Park to Constitution-hill had been given by his late Majesty, and he did not feel justified in advising her Majesty in withdrawing the permission. With those who conceive that the erection of the statue in the contemplated situation will be a disfigurement we do not agree: the arch is a heavy affair, which cannot suffer much from any experiment, and can only be made to appear reasonable by being put to some such purpose. There may be no precedent for such an addition among the ancients, but are we never to be suffered to move one foot from existing modes unless the ancients give us leave? We shall best imitate the ancients by adopting the principle they practised, of making all ornament subordinate to utility, and by holding that good sense is the first principle of good taste, and the most enduring. Those who worship precedent so devoutly worship only the shell: there is no precedent among the ancients for the erection of structures which are in keeping with neither the wants nor opinions of the time, and which are symbolical only of the great truth that ancient modes are worshipped with a blind adoration. There can be little question we conceive that architecture would have been in a far more healthy state among us if not a vestige of Greek or Roman structures had descended to the present generation. We should then have proceeded on the principles on which the ancients proceeded, and which have been productive of such magnificent results, whereas, by descending to the condition of mere copyists, we have always remained behind, and must always so remain so long as authority is suffered to extinguish invention. In our eyes, therefore, it is rather a recommendation than otherwise that this statue is to be placed in a heteredox situation: with the puling dilletanti who are shocked by such innovations, we have no sympathy; and we trust the committee will not suffer their present determination to be overborne by fastidious men of *vertu*, who can only see through Grecian spectacles, and who mistake their accidental associations for the inspirations of heaven. Popular opinion is always in favour of utility taken in the largest sense, and the condition of utility is obviously best satisfied by putting a useless arch to a useful purpose.

*Conduct of the engineer of the Great Liverpool Steamer.*—We have received several letters in reference to our remarks respecting the conduct of the engineer of the Great Liverpool on the occasion of her loss lately on the coast of Spain, some of them questioning the policy of revealing to the world such specimens of misconduct among engineers, but all lamenting deeply that occasion for such animadversion should ever have arisen. To those who question the policy of such disclosures we have only to say that we cannot be a party to the disingenuous courses they would commend to our adoption, and we cannot understand what policy ought to influence a respectable journalist except the policy of speaking the truth without disguise or exaggeration. We have advocated the promotion of nautical and naval engineers to a higher position in the service because we sincerely believe the promotion to be due to their responsibilities, and because we believe that their intelligence and respectability as a class justify and would repay such amelioration. But this conviction cannot blind us to the misdeeds of individual members of the class we commend, and where could be the honesty of showing up all the bright spots of the picture, and concealing all the dark ones? If we descended to such a course we should be mere partizans, and supposing the desire of our correspondents to be gratified, yet of what avail in a great cause could be the shifts and sophistries of mere venal literatti? Our function ws hold binds us to judicial impartiality as nearly as it can be approached; nor if we record great services, must we overlook great faults, if we wish to preserve the verisimilitude of our representations, or maintain any tolerable character for impartiality and fairness.

Our remarks of last month on this subject having been copied into the *Nautical Standard*, a steam navigation paper lately established, the following letter has been sent to the editor of that journal:—

"Sir,—Having seen a paragraph in your paper of the 9th instant, headed 'Steam Boat Engineers' which has thrown great disgrace on the conduct of a part of the engineers of the late Great Liverpool, when in her perilous situation on the morning of the 24th of February, and being acquainted with several engineers, both in the government and merchant service, who I have no doubt would include me amongst the number who left the ship, I consider in justice to the position of the engineer who stopped on board, his name should have been mentioned, as then it would have prevented any slur being thrown on my character for the future. I am proud to think that there was nothing left undone on my part to save the passengers, crew, mail and ship, and at the time the boat mentioned in the paragraph left the ship, I was in the engine-room. While opening the safety valve in case of danger, one of the furnaces exploded, there being at the same time not less than $2\frac{1}{2}$ feet of water over the floor-plates in the stoke-hole. I then left the engine-room, being of no service, and went on deck to assist in carrying out the different orders given by the late commander, Mr. Mc'Leod, and did not leave the ship until ordered by him. If you will give publicity to this you will greatly oblige.—Your obedient servant,

Walter W. Williamson, P.E.,

"but unfortunately acting 4th engineer on the above occasion.

"Southampton, May 16th, 1846."

We mentioned in our former remarks that one of the engineers had remained in the vessel; we did not know his name otherwise we should have published it, but we now pnblish it with much pleasure, and trust that Mr. Williamson's merits will be duly appreciated in those quarters where they will tell most in his favour. The merit of remaining on board in spite of the example of his superiors is much greater than if no such example had been set, and clearly shows Mr. Williamson to be possessed of two of the great qualifications of the marine engineer, courage and conscientiousness. We wish some correspondent would apprize us of the name of the fireman who remained, as his merits in these respects are equally great.

*The Blasco Garay.*—This vessel, built by Mr. Wigram for the Spanish government, and fitted with engines by Messrs. Miller, Ravenhill & Co., we have lately visited; and as these engines are the largest oscillating engines yet at work, we propose making a few remarks respecting them. The diameter of cylinder is 68 inches, and the length of the stroke 6 feet. There are two engines arranged in the usual manner, and two air pumps lying at an angle as prescribed by Mr. Miller's patent, and which has now become a common arrangement. Instead of a slide valve upon one side of the cylinder balanced by a counter weight upon the other, two piston valves with skewed ports, are situated close to the inner trunnion, one being placed on each side of it, whereby the valves balance one another. The steam is conducted to these valves by a belt encircling the cylinder, which receives the steam from the outer trunnion; and where the steam pipe enters the outer trunnion the expansion valve is situated. By this arrangement the steam gets very directly from the cylinder to the condenser, but it would be preferable, we think, if the expansion valve conld be put closer to the slide valve, as expansion will take place in the cylinder jacket, though, we must add, the capacity of this jacket in relation to the size of the cylinder, is not considerable. The stuffing boxes of the cylinder covers are very deep and are fitted through a considerable part of their depth with brass bushes, so as to obviate the tendency of the cylinder wearing oval. The piston packings are metallic, made in Messrs. Miller and Co's usual manner. The boilers are tubular, they are very capacious, are free from priming, and generate a great profusion of steam. The engines are compact, and are very completely arranged; the whole of the handles are conveniently accessible and the valves move very easily. We are more and more convinced that the oscillating engine is the one destined to take the place of the side lever engine, and every new trial of its capabilities adds new proofs of the justice of its claims to this high destiny. The operation of the engines of the "Blasco Garay" on a late occasion when they were tried, was most satisfactory; and the speed of the vessel was such, that she beat some of the fast river-steamers. One great advantage of the oscillating engine is that it enables the paddle shaft to be placed in any situation that is most desirable, and another, that it takes up the least possible room and has the fewest possible parts; so that there is in reality very little left which can break or go wrong. In point of efficiency the oscillating is the same as other engines; in every other point we believe it to be preferable; and into the manufacture of oscillating engines for *all* purposes, the engineering practice of the country, we are convinced, must settle. Those who are foremost in its adoption will reach the largest success, while those who persist in the retention of other systems will only damage themselves by their recusancy, and elevate their more perspicacious brethren to a renown that will cast *them* for the future into the shade.

*The Steamer Ondine.*—This is a vessel constructed by Messrs. Miller, Ravenhill, and Co., for Mr. Baldwin, the proprietor of the *Standard* and *Morning Herald*, and her function is to carry despatches from Calais to Folkestone, at all times and seasons, and with the greatest possible speed. We have taken the occasion of the vessel being at Blackwall, for the purpose of being painted and refitted, to pay her a visit, and must say that we have never seen a handsomer vessel, or one which appeared to us better calculated to fulfil the purposes she was intended to subserve. The hull of the vessel is of iron, of excellent workmanship: the shape seems to be well adapted for speed, and is at the same time so formed as to be calculated to withstand the adverse influences of a stormy sea. The bow rises up with a great deal of shear, and at the same time flams out more than usual, whereby the water is more effectually thrown off, and the vessel is in consequence, a remarkably dry one. The engines are of the oscillating kind, with nearly all the parts of malleable iron: they are symmetrically arranged, and very beautifully finished, and though light, the working parts are stronger than usual. The paddle-wheels are of the feathering variety, and the small crank at the end of the paddle-shaft, by which the parallelism of the floats is maintained, is susceptible of such adjustment that the parallelism is preserved though the shaft falls, as shafts always do in the course of wear. The nominal collective power of the engines is 100 horses, and the vessel, we understand, beats some competitors with 120 horses power, constructed by Messrs. Maudslay. The boilers are tubular, and furnish an abundant supply of steam. The fittings of the vessel are those of a yacht, and we have never seen any vessel more beautifully kept, or in which better order prevailed. Mr. Baldwin, we believe, takes a great pride in the vessel, as he may reasonably do, as such a vessel will create the interest it gratifies.

*Drawings by Palladio.*—Mr. Poynter and Mr. Donaldson have lately drawn up a description of the architectural drawings of Palladio, in the possession of the Duke of Devonshire, for the Institute of British Architects. These drawings are contained in seventeen portfolios and books of folio size, and bound in Russia or Morocco leather. Those in the portfolios are all mounted, apparently on foreign boards, and many of the sheets, having sketches on both sides, are attached to the boards at one end only, so as to leave the back free for inspection. The drawings have the lines in bistre, and some are shadowed with finely-drawn lines, others with a wash tint. They are of two classes, either sketches from original monuments or designs, having dimensions and memoranda upon them, or drawings fairly made out, many of which are probably by another hand, as several are purely elementary drawings of the orders, or plans of temples, sepulchres, and other edifices, most likely prepared for publication. The memoranda are written in the cramped Italian character of the period, with frequent abbreviations and peculiar orthography. There is not the signature of Palladio on any one of the drawings. Some have the name of the edifice to which they relate, others have no indication of the object they are meant to illustrate. Those, which may be presumed to be by Palladio himself, amount to about two hundred and fifty. One portfolio contains four drawings of the Baths of Constantine, entitled "Rovine di Constantino." They consist of a plan, elevation, and section, with dimensions; one portfolio, five drawings of the thermæ of Vespasian; one book, ten drawings of the thermæ of Nero; one portfolio, six drawings of the thermæ of Titus; one portfolio, nine drawings of the thermæ of Diocletian; one ditto, eleven drawings of the thermæ of Antoninus; one ditto, twelve drawings of the thermæ of Agrippa. One portfolio with eighteen drawings, containing a sketch of a cornice attributed to Raphael;—measured plans, elevations, and sections of the amphitheatres at Pola and Verona, and of the Coliseum; plans and sections of ancient theatres, one of which has the Vitruvian diagram inscribed within the outer circumference, instead of being within the Platea. There is also a remarkable set, consisting of the plan, elevation, and section of a beautiful composition, with dimensions and details, similar in style to the Temple of Fortune at Præneste. The subject consists of a vast theatre on the banks of a river; the theatre is surmounted by a succession of terraces, with porticos and flights of steps, leading up to a circular temple, having in front a hexastyle Corinthian portico.—One portfolio with sixteen drawings, ten of which illustrate the Temple of Fortune at Præneste, with plans, elevations, and sections, a restored elevation, elaborate measurements, and restorations of parts, with dimensions, shewing some remarkable and interesting details, of which there now are no vestiges at Palestrina. There are also varions compositions, apparently studies for the restorations of certain courts and porticos; and one drawing of an amphitheatre.—One portfolio with twenty-nine drawings of the Temples of Antoninus and Faustina, of the Pantheon, of Venus &c., at Rome, of Bacchus in the Campagna, of the temples at Tivoli, on the Clitumnus and at Nismes; of the Forum of Nerva, of the basilica of Constantine at Rome, &c.—One portfolio with twenty-eight drawings of the arches of Janus, Constantine, Septimius Severus, Gallienus, and the Porta Maggiore, at Rome; of the ancient arches at Verona and Susa; elevations of a doorway at Spalatro, and of the doorway in the cloister of St. Giorgio Maggiore at Venice; and an elevation of one of Palladio's palaces at Vicenza. —One portfolio with twenty drawings, consisting of various sketches of plans, &c., from the villa Hadriana near Tivoli; of the Septizonium or Portico of Pompey; of the tomb of Theodoric near Ravenna; and miscellaneous elementary drawings of the orders, &c.

The following relate more immediately and exclusively to Palladio's own edifices and works. One portfolio with thirty-one drawings in all, containing an elevation of the scene of the Teatro Olimpico by Gian. Battista Albanesi, and a section of the Cortile of the Convento della Carita at Venice, not by Palladio. The other drawings consist of the original sketches, with dimensions, of various palaces at Vicenza, as the Chiericati, Tiene, &c., and also of many new compositions of facades, original in conception, and very elegant in style, partaking much of the cinque-cento character.—One portfolio with thirteen drawings, and another with twelve drawings, being studies for plans only of palaces and villas.—One portfolio containing eighteen drawings, one sheet with the translation from Vitruvius of the description of the Egyptian and Corinthian Œci, and sections in illustration of the text; the rest are studies for various churches, one of which is a round church with a projecting protico, like that of San Simeone at Venice.—One portfolio with twenty-one drawings of plans, elevations, sections, and parts of the villas Papa Giulio and Madama near Rome; of the palazzo of the Counts Tiene at Vicenza and some drawings of the orders as though prepared in outline for an elementary work. There is also one book endorsed with the words "Heathen Temples, plans, fronts and sections," but the drawings apparently are not by Palladio. It contains thirty-three leaves with plans of temples, principally circular, in Rome and the Campagna; one of a church at Constantiuople, and a portion of the palace of Diocletian at Spalatro.

## ART. IX.—NOVELTIES IN ARTS AND SCIENCE.

*Method of expelling Carbonic Acid Gas from Pits.*—A method of expelling carbonic acid gas from pits, mines, and reservoirs, has lately been projected in France by M. Faucille. It consists in discharging among the gas a volume of steam, whereby the gas is in part expelled, and in part absorbed by the water brought into minute subdivision while the steam is being condensed. For mines we do not think the plan is of any value, and there we have only to recommend, as we have often before stated, large and effectual ventilation. For freeing brewers' tanks, however, and other similar reservoirs from carbonic acid, we think the plan likely to be of service, and in such cases it can be applied readily and without any considerable expense. Mr. Gurney proposes to ventilate mines by an ascending column of steam through the shaft, but the principle of his plan is a different one, being restricted to the single object of producing a draft without displacing any of the gas by contact, or causing it to be partially absorbed by the water in steam.

*New Method of Heating Apartments.*—A new method of heating apartments is said to have been discovered in Germany, whereby it is stated a great economy in fuel may be realized, and a superior effect secured. The improvement is said to have had its origin with Baron Flugel, of Vienna, and Mr. Rothschild, the banker, is said to have taken out a patent for the plan in this country. What the nature of the plan is does not very clearly appear; but of one thing we may be sure—coal only gives out a determinate quantity of heat, and all that a mechanical contrivance can do is to apply that heat with more advantage. A material improvement upon the common stoves would be to make the smoke go through a number of tubes like the tubes of tubular boilers, whereby the heat in the smoke would be more effectually communicated to the air surrounding the tubes.

*Jerningham's Experiments on Saving Lives in Shipwreck.*—Commander Jerningham has lately been making experiments at Woolwich and Yarmouth, under the direction of the Controller of the Coast Guard, on th means of saving lives in cases of shipwreck, and his experiments have been attended with promising results. The plan of procedure consists in firing an anchor on Porter's construction from a mortar—the anchor, however, being so made that both flukes may collapse against the shank. To the anchor a line is attached, and, if a vessel be in danger of shipwreck, by firing an anchor ashore, with a rope attached, the persons on board may generally be saved, as the rope serves to guide a boat or raft through the surf. In Commander Jerningham's experiments the rope was two inches in circumference, and the material Manilla hemp; the charge of powder was 10 ounces, by which the anchor, which weighed 41 lbs., was projected 200 yards, from a $5\frac{1}{2}$ inch brass mortar (the bore of a 24 lbs. shot), at an elevation of 35 degrees. It is intended to illuminate the rope by means of phosphoric oil, the application of which is, we believe, the suggestion of Captain Jerningham. By this contrivance the anchor may be either conveyed from the ship to the shore, or from the shore over the ship. It appears to us that all ships carrying guns of any kind should be provided with such an anchor, and one of the guns could easily be so made as to be suitable for firing the anchor off.

*Comparative Nutritive Powers of Green and Dry Fodder.*—A communication has been made to the Paris Academy of Sciences by M. Boussingault, on the comparative nutritive powers of green and dry fodder for cattle. Hitherto, the received opinion was, that natural or artificial grasses, on their being converted into hay, lose a portion of their virtues. To determine the point, M. Boussingault fed a heifer alternately, for ten days at a time, upon green or dry food, and weighed the animal after each ten days. He found no difference in the average weights; and therefore comes to the conclusion, that the hay made from any given quantity of natural or artificial grass has the same nutrition as the quantity of green food from which it is made. We have but little confidence in the results of such trials. Savants treat the stomach as if it were a retort or alembic, and do not consider the effect which habit and various vital actions may have over the operations of that viscus. M. Boussingault's test, however, is preferable to that which rests the nutritious reputation of a particular substance upon its chemical constitution, but to be of value it should have extended over a lengthened period, and should have comprehended a number of cattle. Ten days is too short a time to prove anything in such a case, and an animal might have been made fatter or leaner during the presumed probation from a mere change of diet, without reference to which species of food was the more nutritious of the two.

## ART. X.—THE SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.—*April 28th.*—The discussion upon the improvement of the Clyde navigation, was renewed by a statement from Mr. Atherton, formerly resident engineer of the Clyde, under Mr. Telford. He gave a brief exposition of the past history of the Clyde navigation, from the time when the only craft on the river were a few herring boats, and the water was suffered to overflow a wide extent on either side of the channel, converting it into an extensive morass. He then gave the various projects for improving the navigation; Smeaton's design for a lock on the main channel, which fortunately was never executed. To Rennie it appeared to be universally admitted must be attributed the credit of propounding the general principle of the Clyde improvements which were commenced under him, and were so successfully continued by Telford and others. Rennie's principle was, that the whole surface waters of the river should be brought within definite limits; that in the lower parts those limits should be very spacious, but gradually and equally diminishing upward, not by sudden "intakes," but by gradual convergence of the restricted width. By this principle the current of the land flood being concentrated, their power of augmenting the depth of the channel would have full opportunity of acting beneficially. It was also expected that the rising tidal waters entering between the widely extended limits of the lower districts, would expend their momentum as they ascended the converging channel in raising the height of the tidal wave, and produce an effect analogous to the extraordinary elevation attained by the tides in the Severn, in consequence of the gradual convergence of the shores of the Bristol Channel. Thus the land floods and the sea tides were to combine in producing useful effects; the velocity of the former in deepening the channel at low water, the latter in preserving or continuing the surface of high water even to Glasgow, at the estuary level. The difficulty was in commencing the works without funds; they were however begun in an economical manner, by running out jetties of fascines of wood and stone, from the opposite sides of the river so as to bring the channel within certain limits. The effect of these jetties was to commence the deepening of the channel by increasing the scour. Owing to the increase of manufactures, and of the iron and coal trade at Glasgow, shipping began to frequent the river; the port dues were kept low, an annual revenue commenced; and greater exertions were made to increase the facilities for admitting ships of greater draught. Telford followed in Rennie's footsteps by unitiug by stone dykes longitudinally the extremities of the projecting jetties; steam dredging boats were employed to cut away the shoals, and diving-bells to remove the rocks which impeded the free current of the stream. Walker followed the same course, and the result was that the depth of water was so increased that instead of only being capable of receiving fishing boats of a draught of water of under 6 feet, vessels drawing 17 feet were tugged by steamers to Glasgow quays, and the annual revenue of the port at present exceeds 50,000*l*. The speaker proceeded to comment with eulogy upon the proceedings of the Clyde trustees and their engineers, and dissented from the views of the Tidal Harbour Commission in their recommendation of opening up the river for the free admission of the tidal water so as to cause them to act by reflux, which it was contended by the speaker generally would not be so effective as continuing to improve the channel and persevering in the same course which had hitherto proved so effectual. Some discussion ensued as to the propriety of some measures adopted in certain parts of the river; but it appeared generally admitted that the work so wisely conceived had been very ably conducted, and that the results were to render the Clyde a model for works under similar circumstances. The discussion was continued so long as to preclude the reading of any papers. That which was announced to be read at the meeting of Tuesday, May 5th, was No. 741, "A descriptive account of the works lately constructed for improving the navigation of the River Severn, with their effect in discharging the flood waters," by E. Leader Williams.

*May 5th.*—The paper read was "A descriptive account of the recent works designed by W. Cubitt, Esq. V.P., for the improvement of the river Severn," by E. Leader Williams, Resident Engineer. The paper commenced by giving an account of the previous condition of the river Severn, between Stourport and Gloucester, which it described as being a succession of deep and nearly quiescent pools separated by a series of rocks and shoals forming comparative rapids. In these new works the remedy adopted was the removal of these fourteen natural drains, and the substitution of four artificial weirs placed diagonally across the channel of the river; in connexion with these weirs were a series of locks placed in artificial lateral channels by means of which the navigation was maintained. These weirs and locks were described as situated at Lincomb, Holt, Bevere, and Diglis; Lincomb being one mile below Stourport, Diglis one mile below Worcester and Holt, and Bevere at intermediate distance. The general dimensions of all the locks resembled that at Lincomb, which was 100 feet long, by 20 feet wide, and 17 feet 9 inches deep, with a lift of 8 feet, and a depth of 6 feet 6 inches over the sills. It is built of stone and brickwork upon a foundation of red sandstone rock. The water was admitted to, and discharged from the lock chamber in a peculiar manner; a lateral arched culvert was built parallel to the side walls of the lock. It communicated with the bottom of the chamber by seven lateral arched openings at right angles to the culvert, and by it 16,000 cubic feet of water flowed in or out of the lock in one minute and a half, and loaded vessels have frequently been passed through in three minutes. The construction of all the locks was described as similar to that at Lincomb. The lock gates were described as being 33 feet 6 inches in height, by 17 feet 6 inches wide; the overhanging portions of the balance beams are of cast iron, and although the total weight of each gate was 16 tons, it was worked by one man. Diagonal iron tie rods were inserted in the framing of the gates from the top of the heel post to the mitre post, at an angle of 45 degrees, and by this arrangement the gates were rendered perfectly firm. The weirs, which are chiefly built across the bed of the river, but in one instance in an artificial channel, were fully described; they are constructed of large rubble stone abutting against a foundation of piling, and vary in length between 300 and 400 feet. The facility with which the freshes are discharged by these weirs, was accounted for by their length, their obliquity and the uninterrupted action of the under current. The advantage of their length was self-evident, and to obtain that it was necessary to carry the line of the upper sill obliquely across the stream, by which an equal discharge was insured throughout the whole length of the weir. The free action of the under-current was also maintained to be an important cause of an efficient discharge of the land waters. It was found that the under-current was improved by the obliquity of the weirs, and less impediment was offered to the water than by weirs placed at right angles to the stream. In fact if the area of the section represented by multiplying the length of the oblique weir into the depth of the sheet of water flowing over it was equal to the area of the direct transverse section of the water of the river above it, the weir offered no impediment to the water, and the stream flowed onwards with a regular velocity. As a proof of this under current it was stated that an old barge which had been laid up as useless, got adrift and sunk in ten feet water, twenty yards above one of the weirs. It continued, undisturbed, during the short water season, but the first heavy fresh raised it from the bottom and laid it on the upper sil of the weir, there not being sufficient water to carry it over. Another instance of the free action of the under current was, that the channel not only maintained its original depth, but was scoured out, in some instances, to a depth of two feet. A series of experiments made in connection with these works proved, that the under current flowed in lines parallel to the surface of the river till it reached the foot of the weir. As an illustration of this point, a float, which was loaded in such a manner as to swim at different depths, approached the weir, in a line parallel to the surface until it came nearly close to the upper sill of the weir where it rose and formed a parabolic curve in the passage over it. The fall at low water between Stourport and Worcester was stated to be at the rate of 21 inches per mile, while between Worcester and Gloucester it was only at the rate of $4\frac{3}{4}$ inches per mile. On account of this variation a different mode of improvement was then adopted, viz:—removing the shoals by dredging, and constructing a series of embankments, for the purpose of equalising the width and depth of the river. The whole series of locks and weirs between Stourport and Gloucester was completed by Messrs. Grissell and Peto, the contractors, in the short space of fifteen months. The works have been satisfactorily tested by the floods of two winters, and the efficiency of the weirs in discharging the flood waters has been fully demonstrated.

*May 12th* and *19th.*—The first of these evenings was entirely occupied by the renewed discussion upon Mr. Williams "Description of the new works for rendering navigable the upper part of the river Severn."—The theory of the oblique weirs was strongly contested on the ground, that although by its obliquity, the obstruction to the stream was more gradual, yet that the vertical obstruction must exist to the extent of the cubic content of the object placed in a channel of given dimensions. After much discussion, in which it was argued that the real position assumed by Mr. Cubitt in his design for these weirs had not been perfectly seized by the members, it was shewn that the intention of the works was, to place such weirs in the river as should at all times retain a depth of water sufficient for the navigation even in the shoalest spots,—and that such weirs should be so constructed as to permit of the free passage of the water without raising it higher in times of 'freshes' or floods than it had been raised in times of similar floods before the construction of such weirs. This, it was satisfactorily shewn, had been done by the oblique weirs, and that the navigation by means of lateral locks, enabled a certainty of transport of merchandize to be attained which could not previously be thought of, and at the same time the drainage of the country had not been at all deteriorated by the regular medium height of the water in the river.

The paper read was "on the combustion of fuel under steam boilers, with a description of Bodmer's fire grate," by J. G. Bodmer, M. Inst, C.E.

This paper, after drawing attention to the importance of ensuring a more perfect combustion of the fuel used in furnaces than has hitherto been attained by the ordinary methods, proceeded to give a description of the new firegrate by which the author arrived at the desired object. The main feature of this grate consisted in the ends of the fire bars being laid in the threads of two parallel endless screws placed longitudinally beside the fire space and revolving slowly, so as to move the grate bars gradually forward. The fresh fuel being thus received on a bare surface, and consecutively moved towards that portion in a state of ignition; more perfect and effective combustion of the fuel and the gases, was stated to have taken place than could be obtained by the ordinary method of throwing the fresh fuel on an ignited surface, for in the latter case the gases suddenly developed passed off to a considerable extent through the flues as smoke without being ignited, and a considerable waste of fuel was the consequence, which it was the principal object of this grate to avoid. The fire bars, on arriving at the farther end of the machine descended on to another parrallel pair of endless screws which had a contrary motion to the upper pair, and thus restored the bars to the front of the grate where they were again lifted up to the upper screws by means of levers, and were in a position to receive fresh coals, and again to be moved onwards into the fire. A rocking motion was communicated to them by a drunken thread so as to prevent the spaces from filling with clinkers. The paper then proceeded to notice the applicability of the grate to all situations in which furnaces were required, and concluded by contending, that with the more perfect combustion that would be insured, a less draught, and consequently less fuel would be required, which it was maintained was an object of great interest, when it was considered that millions of tons of coals were annually consumed in this country, and that with a daily increasing consumption, the time might ere long arrive when any means by which even a small saving of fuel might be effected, would be looked upon as a matter of paramount importance.

Sir John Rennie, president, announced that the first of the series of his soirees would be held June 13th, and that it was his intention this season to repeat them on the evenings of Saturday, June 20th, and 27th, and July 4th. The members were requested to co-operate in procuring interesting models and works of art for these meetings.

Society of Arts.—*April 29th.*—The first communication read was by W Spence, Esq. on Mr. Godson's Patent Furnace for consuming smoke and economising fuel. The general features of the furnace, and the parts of which it is composed, may be thus described: a box with a moveable bottom or feed-plate for the fuel, and fitting its internal surface, is substituted for the ordinary bars in the middle of the furnace, and is capable of being raised or lowered within the box or chamber, which is made to occupy a position in the ash-pit below the furnace. The fuel is fed on the plate while in its lowered position, and when raised it is introduced into the centre of the fire, by which means the smoke evolved from the fresh fuel is consumed. In order however to render such a mode of supplying fuel available for its purpose, it is necessary that at the time when the feed-plate in the centre of the furnace is to be lowered to receive its charge, the portion of burning fuel resting thereon should be supported; for this purpose two plates of metal are made to enter the furnace, one on each side, and meeting in the centre. Again it is requisite for the due promotion of the draft of the furnace, that inasmuch as the centre support of the fuel consists of a dead plate, that plate should be kept a little below the fire-bars, and that a series of oblique bars should be formed, and extend from the ordinary fire-bars to the plate. A model and diagrams of the invention were exhibited, and a lengthened discussion took place as to the merits of thc invention.

Moses Ricardo, Esq., described a machine to register the velocity of railway trains. The machine consists of two parts, one receives motion from the carriage, the other from a clock-work movement; they are arranged in the following manner:—an eccentric is placed on the axle of the carriage, and gives motion by means of a connecting rod to a lever attached to the machine, which lever acts upon a ratchet wheel, and is so arranged that each revolution of the wheel of the carriage advances the ratchet one tooth. An endless screw is turned on the spindle of the ratchet-wheel and gives motion to a small-toothed wheel below, on the spindle of which is fixed what may be termed a lateral eccentrie. as one part projects more than the other on the side of the wheel: against this the short end of a horizontal lever is pressed by means of a spring. As the eccentric revolves from the projecting to the lower part, it moves the lever, and with it a pencil fixed at its other end in one direction, till it reaches the lowest point, when by the pressure of a spring it takes the opposite direction till it reaches the highest point, when it returns again. The wheels are so arranged that this eccentric makes one revolution in each mile that a train travels. The clock-work is used to turn a drum, upon which a ruled paper is wound. When the train is stopping at a station, the pencil is stationery, and marks only a straight line; but when in motion, diagonal lines are drawn by the action of the lever, as described. The extreme distance between the two points of the diagonal lines determines the velocity at which the train has been travelling. Thus the train is made by this apparatus to keep a perfect register of the work done ,and would at all times be a reference by which the neglect of either the engineer or conductor could be dctected by the superintendent.

*May 6th.*—The first communication read was by W. Everett, Esq., on an improved poppet-head for turners. Mr. Everett observed, that the first attempt at improving the poppet-head was, to take off the point and insert a screw, carrying a spindle and wheel, fitted up as a drill, to be driven by the overhead motion, and this was found to answer very well, when the hole to be drilled could be brought in a line with the drill. This having been done, it was expected that it was possible to make this part of the lathe more useful; in fact, a substitute, in a great measure, for the slide-rest. The following motions have, therefore, been given to the point. First, an upward and downward motion, so that it can be applied to all lathes. Secondly, a circular motion, which enables it to be applied at any required angle. And, Thirdly, a motion directly across the mandril.

The second communication was by Mr. A. J. Green, on the ventilation of buildings. The paper commenced with an account of the various plans which the author had adopted for the purpose of ventilating the sick ward and other rooms of the Sudbury Union Workhouse, and it then proceeded to point out the way in which he would propose that all large buildings, about to be erected, should be built. Where a double chimney is to be erected I would propose (says Mr. Green,) that two air-flues should be carried up in the stack, as near the centre as they can be got. If the chimnies are not in the centre of the side or end of the room the flues should be carried so as to bring them as nearly into that position as possible. The flues need not be more than 14 in. by 6 in.; or, from 9 in. by 9 in.; and should be commenced from the first-floor and continued through every successive story to the top of the chimney, in the same way as the flues for the smoke. One flue, of the above size, would be sufficient to ventilate four or five stories, if each room required it. Valves would require to be fixed in the wall, or ceiling, in conncction with the flue. This system of ventilation Mr. Green considers would be very applicable to smoking-rooms, tap-rooms, eating-houses, or any buildings where a large number of persons assemble.

The third communication was by Mr. Warriner, on the concentrated gravy of meat. This article is manufactured at Sidney, New South Wales, from the carcasses of oxen and sheep, and which are bred there for the sake of their tallow, wool, hides, and bones. The value of oxen in Australia is from 15*s.* to 20*s.*, and of sheep, 1*s.* 6*d.* to 2*s.* 6*d.* each. During the last year, the leg-bones of upwards of 109,000 oxen were sent over to this country, the greater part of the flesh of the animals having been thrown away. The object of the present manufacture is, to render down the lean of the carcases into a solid portable soup, by stewing it down in its own gravy without water, in double pans. By reducing it in this way the water in the lower pan prevents thc fire passing through, and giving to the soup the burnt flavour which it has always hitherto had. When manufactured it is sold in cakes, of various sizes, at the rate of 1*s.* per lb. One pound of the is said to be equal to 24 lbs. of the best gravy beef.

## Art. XI.—LETTERS TO THE CLUB.

*Practical recommendations respecting tubular boilers.*—Do not make the fire bars less than three feet in length, else the riper bar will lift them up when an attempt is made to ripe the fire, the furnace bars will fall down and the whole fire above that length of bars be precipitated into the ash-pit. Place a door in the furnace bridge below the level of the bars so that the ashes which accumulate behind the bridge and the soot pushed out of thc tubes when they are cleaned, may easily be removed by opening this door. If the boiler is liable to prime do not let the steam be high when the vessel starts, but let all the fires be low, and be brought up by degrees. A blow-off apparatus which blows from near the surface of the water will obviate priming very much, as the impalpahle particles within the boiler, of which scale is elaborated cause the water to foam, and the removal of those particles, which a suitable blow-off apparatus will effect, will greatly abate the evil. For these recommendations I am indebted to Mr, Gray engineer of the Tagus, and I send them to you in the hope they may be of service. S.S

*Tubular and Water Space Boilers.*—The following observations on boilers in reply to your remarks on my last letter, I think you will find both interesting and useful to some of your readers:—

First,—With reference to fire blocks for protecting parts of tubular boilers, you defend the use of them on the plea of the bad conducting power of the metal and in order to establish this assumed point; you refer to the burning of the rivet-heads, and double thicknesses of metal in locomotive furnaces; " two blacks do not make a white;" the water spaces round locomotive furnaces are made on the same unphilosophical plan as the water spaces of the tubular marine boilers that require the fire blocks. The same space has both to let steam pass up through it, and to let water pass down through it at the same moment; and, as a matter of course, the water and steam interrupt each other, and the plates are burned. In the article on the management of marine engines you have laid down a very proper and correct rule, viz.:—" In every case in which there is an accummulation of scale in the boiler the fault lies with the engineer." The following rule is also correct, with reference to boilers that are free from scale. In every case in which the metal of a boiler is burned, either after short or long use of the boiler, the fault lies in the managcment of the water spaces. The degree of malformation of the water space arrangement will be cxactly in proportion to the length of time taken to burn the metal. In a boiler of which the water spaces are badly arranged, the thick metal, such as rivet-heads and doubling of plates will first be burned; but in a boiler the water-spaces of which are properly arranged, no practicable thickness of metal will be burned. You are quite wrong in supposing that it is from the want of sufficient conducting power of the metal, that the thick portions of it are so easily burned in those boilers the water-spaces of which are arranged according to the rule of thumb. I have made a number of experiments on this subject which clearly established the point that no practicable thickness of metal for boilers will be burned although exposed to the most intense heat, continued for a length of time, provided the metal has always water in contact with it. It is the absence of water for short intervals of time from the metal of common boilers, which causes it to be burned.

Second,—You say Hancock, and other steam coach proprietors long ago adopted narrow water space boilers, excusing the excentricity by the great lightness of such a construction: here you are right; and every one who examines the two plans of boiler, will admit that a lighter and a more powerful boiler can be made in a given space with narrow or sheet water spaces than can be made with tubes : lightness was the only redeeming point in Hancock's boiler. He had no means provided in it for the circulation of the water, and consequently the boilers were soon burned; the plates of his boilers were only the eighth part of an inch thick. Surely you will never refer the burning of these plates to the non-conducting power of the metal? No! it was the stagnant condition of the water in those boilers that wrought their ruin.

Again, you say, " Perkins long ago insisted on the importance of establishing distinct channels for the different currents of water;" so he did; but his method of obtaining the circulation of the water was not practically good, because it could only be applied to some kinds of boilers, and that not in the most advantageous manner. Gurney was the first inventor of a boiler, the existence of which depended on currents of water circulating through it. It was patented in 1825. It was a tubular boiler, and in his specification he makes a general claim for tubular boilers of any plan or arrangement of tubes having currents of water passing through them. The misfortune of Gurney was, that in practice he adopted a plan of boiler which completely nullified the grand principle for which he had taken out a patent. The tubes in his boiler were twisted into all the extraordinary shapes that can be imagined, and the result was that his boilers were burned, owing to accumulation of steam in the bent tubes. The circulation in a boiler depends on the ease and rapidity with which the steam can ascend from the place where it is formed to the surface of the water, every obstacle that prevents the ascent of the steam is sure to be burned if thc said obstacle is acted on by fire; therefore the water spaces in which steam is produced in boilers ought to be as straight and as perpendicular as possible. Gurney's tubes were not perpendicular, or his boiler would have done well. Hancock invented the lightest boiler ever made; Gurney first suggested the idea of constructing boilers so as to render the circulation of the water available for preventing accumulations of steam in the water spaces. The boiler which I have invented is constructed on purpose to combine in one the advantages of these two boilers.

Third,—Allow me now to give a few hints on improvements in tubular boilers. The common form of tubular boilers with the horizontal tubes, and the smoke passing through them is the very worst arrangement that could be planned as far as the free 'access' of the water around the tubes is concerned. From the horizontal position of the tubes, and the close manner in which they are set, it is quite evident that all the surface of the tubes cannot be good heating snrface, for it is impossible that the steam can get freely out from among them. In marine boilers, where the furnaces are placed beneath the tubes, this evil is much exaggerated, because all the steam produced at the furnaces is obliged to pass up through the narrow spaces between the tubes before it can reach the surface of the water: therefore, the tubes immediately above the centre of the furnaces must be supplied with steam or froth instead of solid water. It is this bad arrangement of the water-spaces which causes the great oscillation of the water level in these boilers. There are many arrangements for tubular boilers that might be suggested superior to the plan just referred to; I shall give one that has the advantage of possessing separate spaces for the ascending and descending currents in the boiler.

*Description of Boiler.*—The tubes to be placed in a perpendicular position in a chamber behind the furnaces, the water to be within the tubes and the smoke to pass outside of them. A water space to be made along underneath the tubes, from which each tube would receive a supply of water, the upper ends of the tubes being open to let steam, or water rush out. At each side or any other convenient part of the boiler, a descending water space must be provided through which a free communication will exist between the water spaces above and below the tubes. All the water thrown out at the top of the tubes will descend again to the bottom of the boiler through the descending water space. The successful working of this boiler will altogether depend on the width or area of the descending water space. The formation of the steam in the tubes, and the ascent of it up through them will set in motion such portions of the water within them as is not at that instant converted into steam, or, in other words, the whole contents of the tubes whether steam or water has a motion npwards in the tubes. If the boiler is constructed with a deficient descending water space, the water will be thrown out of some of the tubes, and they will be partially filled with steam, in consequence of the descending water space not being large enough to let down the amount of water which ought to be going in at the lower end of the tubes. But if the cross sectional area of the descending water space is made equal to the total cross sectional area of all the tubes, then there will be nothing to prevent the water going down in the descending water space with the same velocity as the steam and water are rushing up through the tubes at; and consequently the tubes will have a steady supply of water always going in at their lower ends. In practice I have found boilers constructed on this principle work better if the descending water space is greater in area than the ascending. The above described plan of boiler I warrant will give satisfaction if adopted, and there will be no complaint found of the bad conducting power of the metal. There is no patent right to interfere with any one trying it. I remain, &c.,

Willow Park, Greenock. JAMES JOHNSTONE.

[We agree with Mr. Johnstone in thinking that 'it is the absence of water from the metal of common boilers which causes it to be burned;' and it is therefore we are opposed to his tall vertical flues, which by retaining some steam in the landings of the plates and other irregularities of surface, prevent the access of water in those situations. We do not consider this opinion inconsistent, however, with the belief that the injury would not take place but for the imperfect conducting power of the metal, for, if the conducting power of the metal was perfect, the heat would be conducted edgeways through the plate as fast as it was received, and the temperature could never rise to an injurious degree. We have no objection to make to Mr. Johnstone's descending currents, and we think special provision for such currents in some kinds of boilers is necessary; but we take exception to the doctrine that they are in every case indispensable and all sufficing. Our objection to Mr. Johnstone's boiler is not that it has a special provision for maintaining a current, but that his water spaces are such that they must become choked up, and his boiler be destroyed when subjected to the deranging influences which exist in practice. The arrangement of tubular boilers recommended by Mr. Johnstone with water within the tubes has been adopted by Mr. David Napier in several steam vessels now plying upon the Thames. Those boilers are found to prime very much, and on several occasions some of the tubes have been burned from chips, pieces of waste, or some other substance which had obtained admission into the boiler, being sucked into the lower orifices of the tubes. The balls of deposit formed within the boiler have sometimes produced the same result.]

## ART. XII.—PAPERS FOR REFERENCE.

### EXPERIMENTS ON THE STRENGTH OF WROUGHT IRON TUBES, BY MR. FAIRBAIRN.

The first class of experiments are upon cylindrical tubes; the second upon those of the elliptical form; and the last upon the rectangular kind. Tubes of each sort have been carefully tested, and the results recorded in the order in which they were made; and moreover, each specimen had direct reference to the intended bridge, both as regards the length and thickness as also the depth and width. In the first class of experiments' which are those of the cylindrical form, the results are:—

*Cylindrical Tubes.*

| Number of Experiments. | Distance between Supports. | Diameter in inches. | Thickness of plate in inches. | Ultimate Deflection in Inches. | Breaking weight in lbs. | Remarks. |
|---|---|---|---|---|---|---|
| | ft. in. | | | | | |
| 1 | 17 0 | 12.18 | .0408 | .39 | 3,040 | Crushed top |
| 2 | 17 0 | 12.00 | .0370 | .65 | 2,704 | Ditto. |
| 3 | 15 7½ | 12.40 | .1310 | 1.29 | 11,440 | Torn asunder at the bottom. |
| 4 | 23 5 | 18.26 | .0582 | .56 | 6,400 | Ditto |
| 5 | 23 5 | 17.68 | .0631 | .74 | 6,400 | Ditto |
| 6 | 23 5 | 18.18 | .1190 | 1.19 | 14,240 | Ditto |
| 7 | 31 3¼ | 24.00 | .0954 | .63 | 9,760 | Ditto |
| 8 | 31 3¼ | 24.30 | .13501 | .95 | 14,240 | Ditto |
| 9 | 31 3¼ | 24.20 | .0954 | .74 | 10,880 | Ditto |

With the exception of the first two, nearly the whole of the tubes were ruptured by tearing asunder at the bottom through the line of the rivets.

*Elliptical Tubes.*

| Number of Experiments. | Distance between supports. | Diameters, transverse and conjugate, in inches. | Thickness of plates in inches. | Ultimate Deflection in inches. | Breaking weight in lbs. | Remarks. |
|---|---|---|---|---|---|---|
| | ft. in. | | | | | |
| 19 | 17 0 | 14·62 / 9·25 | ·0416 | ·62 | 2,100 | Crushed on top. |
| 20 | 24 0 | 21·66 / 13·15 | 1·1320 | 1·36 | 17,076 | Broke by extension. |
| 21 | 24 0 | 21·25 / 14·12 | ·0688 | ·45 | 7,270 | By compression. |
| 22 | 18 6 | 12·00 / 7·50 | ·0775 | ·95 | 6,867 | By compression. This tube had a fin on the top side. |
| 24 | 17 6 | 15·00 / 9·75 | ·1430 | 1·39 | 15,000 | Both sides were ruptured. |

It will be observed that the whole of these experiments indicated weakness on the top side of the tube, which in almost every case was greatly distorted by the force of compression acting in that direction. It is probable that those of the cylindrical form would have yielded in like manner, had the rivetting at the joints been equally perfect on the lower side of the tube. This was not, however, the case, and hence arises the cause of rupture at that part.

*Rectangular Tube*

| No. of Experiments. | Distance between Supports. | Depth in inches. | Width in inches. | Thickness of Plate in inches. Top. | Thickness of Plate in inches. Bottom. | Ultimate Deflection in inches. | Breaking weight in lbs. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| | ft. in. | | | | | | | Broke by |
| 14 | 17 6 | 9·6 | 9·6 | ·075 | ·075 | 1·10 | 3,738 | Compression. |
| 14 | 17 6 | 9·6 | 9·6 | ·272 | ·075 | 1·13 | 8,273 | (Rev.) Exten. |
| 15 | 17 6 | 9·6 | 9·6 | ·075 | ·142 | 0·94 | 3,788 | Compression. |
| 15 | 17 6 | 9·6 | 9·6 | ·142 | ·075 | 1.88 | 7,148 | Extension. |
| 16 | 17 6 | 18·25 | 9·25 | ·059 | ·149 | 0·93 | 6,812 | Compression. |
| 16 | 17 6 | 18·25 | 9·25 | ·149 | ·059 | 1·73 | 12,188 | Ditto |
| 17 | 24 0 | 15·00 | 2·25 | ·160 | ·160 | 2·66 | 17,600 | Ditto |
| 18 | 18 0 | 13·25 | 7·50 | ·142 | ·142 | 1·71 | 13,680 | Ditto |
| 23 | 18 6 | 13·00 | 8·00 | ·066 | ·066 | 1·19 | 8,812 | Ditto Circular bot. fin at top. |
| 29 | 19 0 | 15·40 | 7·75 | ·230 | ·180 | 1·59 | 22,469 | Sides distort. Corrugated top. |

On consultiug the above table, it will be found that the results, as respects strength, are of a higher order than those obtained from the cylindrical and elliptical tubes, and particularly those constructed with stronger plates on the top side, which, in almost every experiment where the thin side was uppermost, gave signs of weakness in that part. Some curious and interesting phenomena presented themselves in these experiments—many of them are anomalous to our preconceived notions of the strength of materials, and totally different to anything yet exhibited in any previous research. It has invariably been observed, that in almost every experiment the tubes gave evidence of weakness in their powers of resistance on the top side to the forces tending to crush them. This was strongly exemplified in experiments 14, 15, 16, &c. With tubes of a rectangular shape, having the top side about double the thickness of the bottom, and the sides only half the thickness of the bottom, or one-fourth the thickness of the top, nearly double the strength was obtained. In experiment 14 (marked in the margin of the above table), a tube of the rectangular form $9\frac{1}{2}$ inches square, with top and bottom plates of equal thickness, the breaking weight was 3,738 lbs.; rivetting a stronger plate on the top side, the strength was increased to 8,273 lbs.; the difference being 4,535 lbs.—considerably more than double the strength sustained by the tube when the top and bottom sides were equal. The experiments given in No. 15 are of the same character, where the top plate is as near as possible double the thickness of the bottom. In these experiments, the tube was first crippled by doubling up the thin plate on the top side, which was done with a weight of 3,788 lbs.; it was then reversed with the thick side upwards, and by this change the breaking weight was increased to 7,148 lbs.; making a difference of 3,360 lbs., or an increase to nearly double the strength, by the simple operation of reversing the tube, and turning it upside down. The same degree of importance is attached to a similar form, when the depth in the middle is double the width of the tube. From the experiments in No. 16, we deduce the same results in a tube where the depth is $18\frac{1}{4}$ and the breadth $9\frac{1}{4}$ inches. Loading this tube with 6,812 lb. (the thin plate being uppermost), it follows precisely the same law as before, and becomes wrinkled, with a hummoc rising on the top side, so as to render it no longer safe to sustain the load. Take, however, the same tube, and reverse it with the thick plate upwards, and you not only strengthen the part previously injured, but you increase the resisting powers from 6,812 lbs. to 12,188 lbs. Let us now examine the tube in the 29th experiment, where the top is composed of corrugated iron, forming two tubular cavities, extending longitudinally along its upper side. This, it will be observed, presents the best form for resisting the "puckering," or crushing force, which, on almost every occasion, was present in the previous experiments. Having loaded the tube with increasing weights, it ultimately gave way by tearing the sides from the top and bottom plates at nearly one and the same instant after the last weight 22,469 lbs. was laid on. The greatly increased strength indicated by this form of tube is highly satisfactory: and provided these facts be duly appreciated in the construction of the bridge, they will, I have no doubt, lead to the balance of the two resisting forces of tension and compression. The results here obtained are so essential to this inquiry, and to our knowledge of the strength of materials in general, that I have deemed it essential, in this abridged statement, to direct attention to facts of immense value in the proper and judicious application, as well as distribution, of the material in the proposed structure. Strength and lightness are desiderata of great importance, and the circumstances above stated are well worthy the attention of the mathematician and engineer. For the present we shall have to consider, not only the due and perfect portion of the top and bottom sides of the tube, but also the stiffening of the sides with those parts, in order to effect the required rigidity for retaining the whole in shape. These are considerations which require attention; and till further experiments are made, and probably some of them upon a larger scale, it would be hazardous to pronounce anything definite as to the proportion of the parts, and the equalization of the forces tending to the derangement of the structure. So far as our knowledge extends, and judging from the experiments already completed, I would venture to state that a tubular bridge can be constructed of such powers and dimensions as will meet, with perfect security, the requirements of railway traffic across the Straits. The utmost care, must, however, be observed in the construction, and probably a much greater quantity of material may be required than was originally contemplated before the structure can be considered safe. In this opinion Mr Hodgkinson and myself seem to agree; and although suspension chains may be useful in the construction in the first instance, they would nevertheless be highly improper to depend upon as the principal support of the bridge. Under every circumstance, I am of opinion that the tubes should be made sufficiently strong to sustain, not only their own weight, but in addition to that load, 2,000 tons equally distributed over the surface of the platform, a load ten times greater than they will ever be called upon to support. In fact, it should be a huge sheet-iron hollow girder, of sufficient strength and stiffness to sustain those weights; if the parts be well proportioned, and the plates properly rivetted the chains may be stripped off.

W. Fairbairn.

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## REPORT ON THE METROPOLITAN SEWAGE MANURE BILL.

Having taken into consideration the papers, plans, and drawings relating to the Metropolitan Sewage Manure Company, forwarded to us for the purpose of reporting our opinion whether any danger to the public health, or any nuisance or inconvenience, would be likely to arise from the operations of the proposed company in the neighbourhood of any part of their works or elsewhere, and having inspected the documents deposited in the Private Bill-office, we have the honour to state as follows:—

1. We fully appreciate and agree in the principle that the sewage of towns should be applied, wherever practicable, to the production of human food, instead of being wasted and lost, as is now too frequently the case. We are aware that the loss sustained in this manner by London and its environs is enormous, and we view the employment of the Metropolitan Sewage as an object highly deserving public attention and support.

2. While, however, we regard thus favourably the general principles of the application of town refuse to productive purposes, we recollect, at the same time, that much injury to public health has arisen from imperfect conception and execution of works of drainage, and that it is essential to examine carefully the construction of such works as might prove injurious by the accumulating of decaying refuse, or which, from their nature are likely to affect the health of certain districts. We, therefore, consider that any plan for such application of sewage, should not only in its minor details secure the public from any injurious effects to the public health or to property caused by the working out of the plan itself, but also that it should not interfere with any future adjustments of the present divided metropolitan arrangements for sewage to some more general and comprehensive system, which may hereafter be thought advisable by the Legislature, and which has already engaged the attention of the Health of Towns Commissioners. Many provisions in the bill of the proposed Metropolitan Sewage Manure Company would appear to be founded on the supposition that the mode of sewerage at present adopted by the Westminster Commissioners of Sewers would not be changed or modified, and that the sewers named King's Scholars'-pond sewer and Ranclagh sewer would remain permanent in their present condition. We are of opinion that great inconvenience might arise from this supposition, since, should a modification of the present system of drainage and sewerage of the district be contemplated, in accordance with any comprehensive plan for that of the metropolis generally, difficulties might arise from having an authorized company established for drawing their sewage waters from a locality which might be included in the general plan.

3. While we ascertain by clause 5 in the bill, that powers are demanded for "collecting, impounding, and carrying away the sewage waters," and by clause 18, that "20 acres may be devoted for the purpose of constructing stations, tanks, engines, and other conveniences," for this purpose, we do not find either in the papers forwarded, or in the plans deposited in the Private Bill Office, sufficient insight into the mode of tanking, raising, or distributing the sewage waters, to enable us to form a correct judgment respecting it, or whether it can be carried into operation without detriment to the public health. We do not in any of the clauses perceive a guarantee to the public against the accumulation of decaying matter, or the emission of putrid emanations; but on the contrary, observe that power is demanded, under the general terms "tanks" and "conveniences," which might be devoted to the collection of such refuse in a manner highly injurious to public health. We conceive that on a matter so important to the public the most minute information shouldhave been deposited, and the most ample guarantees given. In the memorial of the inhabitants of the parish of St. John the Evangelist, Westminster, and St. George's, Hanover-square, the memorialists anticipate stagnation to the present drainage by the proposed works of the company, and fear leakage from the pipes containing the sewage water under considerable pressure. These certainly would be grave objections, if well founded; but the absence of proper plans and information prevent us either confirming or refuting them. The cisterns alluded to in the memorial of the Rev. Dr. Benson, perpetual curate of Hounslow, would require great care in their construction to prevent emanations injurious to health; but while we perceive that the bill takes general powers, which may be construed into the power for erection of tanks, cisterns, &c., we nowhere find them detailed in the deposited drawings or plans, unless the embankment of ten feet on the deposited section relating to Staines and Egham, now abandoned, be considered in this light.

4. Viewing the general powers contained in clause 5 as too great without definition of the works proposed, we altogether object to the general powers demanded in clause 15, of making and changing the plans at the discretion of the engineers of the company and of the surveyor of the Westminster Commission of Sewers, especially as this clause affords no efficient control for protecting the interests of the public, but refers the matter in dispute to a third party, irresponsible to the public.

5. In conclusion, from the absence of specified plans, when such plans, from the character of the scheme, are especially important to the interests of the public; from the general powers demanded in clauses 5 and 18, without specification; and from the objectionable mode of preparing and altering plans referred to in clause 15, we feel it our duty to report, that we do not find sufficient protection from injury to the public health, or from nuisance and inconvenience to the public, in the bill of the Metropolitan Sewage Manure Company, now before Parliament.

H. T. DE LA BECHE.
GEO. STEPHENSON.
LYON PLAYFAIR.

May 14th, 1846.

REMARKS RESPECTING WROUGHT-IRON TUBULAR BEAMS, BY MR. EATON HODGKINSON.

*Cylindrical Tubes.*—The strength of a cylindrical tube, supported at the ends, and loaded in the middle, is expressed by the formula

$$w=\frac{\pi f}{a\,l}\,(a^4-a'^4).$$

Where $l$ is the distauce between the supports; $a$, $a'$ the external and internal radii; $w$ the breaking weight: $f$ the strain upon a unity of section, as a square inch, at the top and bottom of the tube, in consequence of the weight $w$; $\pi=3{\cdot}14159$.

From this formula we obtain

$$f=\frac{w\,l\,a}{\pi\,(a^4-a'^4)}.$$

As it will be convenient to know the strain $f$ per square inch, which the metal at the top and bottom of the tube is bearing when rupture takes place, this value will be obtained from each of Mr. Fairbairn's experiments: the value $w$ being made to include, besides the weight laid on at the time of fracture, the pressure from the weight of the tube between the supports, this last being equal to half that weight. Computing the results we have, from

Experiment 1, $f=33456$
„ 2, $f=33426$
„ 3, $f=35462$
„ 4, $f=32415$
„ 5, $f=30078$ } Mean 29887 lb.=13·34 tons.
„ 6, $f=33869$
„ 7, $f=22528$
„ 8, $f=22655$
„ 9, $f=25095$

Fracture in all cases took place either by the tube failing at the top, or tearing across at the rivet holes; this happened on the average, as appears from above, when the metal was strained $13\frac{1}{3}$ tons per square inch, or little more than half its full tensile strength.

*Elliptical Tubes.*—The value of $f$ in an elliptical tube broken as before, (the transverse axis being vertical), is expressed by the formula.

$$f=\frac{w\,l\,a}{\pi\,(b\,a^3-b'\,a'^3)}.$$

Where $a$, $a'$ are the semi-transverse external and internal diameters; $b$, $b'$ the semi-conjugate external and internal diameters; and the rest as before, $w$ including in all cases the pressure from the weight of the beam.

Computing the results from Mr. Fairbairn's experiments, we have from

Experiment 20, $f=36938$ lb.
„ 21, $f=29144$ } Mean 37089 lb.=16·55 tons.
„ 24, $f=45185$

*Rectangular Tubes.*—If in a rectangular tube, employed as a beam, the thickness of the top and bottom be equal, and the sides are of any thickness at pleasure, then we have

$$f=\frac{3\,w\,l\,d}{2\,(b\,d^3-b'\,d'^3)}.$$

in which $d$, $d'$ are the external and internal depths respectively; $b$, $b'$ the external and internal breadths; and the rest as before.

Mr. Fairbairn's experiment No. 14 gives by reduction

$f=18495$ lb.=8·2566 tons.

This is, however, much below the value which some of my own experiments give, as will be seen further on.

The value of $f$, which represents the strain upon the top or bottom of the tube when it gives way, is the quantity per square inch which the material will bear either before it becomes crushed at the top side or torn asunder at the bottom. But it has been mentioned before, that thin sheets of iron take a corrugated form with a much less pressure than would be required to tear them asunder; and therefore the value of $f$, as obtained from the preceding experiments, is generally the resistance of the material to crushing, and would have been so in every instance if the plates on the bottom side (subjected to tension) had not been rendered weaker by rivetting.

The experiments made by myself were directed principally to two objects:—

I.—To ascertain how far this value of $f$ would be affected by changing the thickness of the metal, the other dimensions of the tube being the same.

II.—To obtain the strength of tubes, precisely similar to other tubes fixed on, but proportionately less than the former in all their dimensions, as length, breadth, depth, and thickness,—in order to enable us to reason as to strength from one size to another, with more certainty than hitherto, as mentioned before. Another object not far pursued, was to seek for the proper proportion of metal in the top and bottom of the tube. Much more is required in this direction.

In the three series of experiments made, the tubes were *rectangular*, and the dimensions and other values are given below.

| Length. | Depth. | Breadth. | Distance between supports. | Weight. | Thickness of Plates. | Last observed Deflection. | Corresponding Weight. | Breaking Weight. | Value of $f$, for crushing strain. |
|---|---|---|---|---|---|---|---|---|---|
| ft. in. | in. | in. | ft. in. | cwt. qr. | Inch. | Inch. | Tons. | Tons. | Tons. |
| 31 6 | 24 | 16 | 30 0 | 44 3 | ·525 | 3·03 | 56·3 | 57· 5 | 19·17 |
| 31 6 | 24 | 16 | 30 0 | 24 1 | ·272 | 1·53 | 20·3 | 22·75 | 14·47 |
| 31 6 | 24 | 16 | 30 0 | 10 1 | ·124 | 1·20 | 5·04 | 5·53 | 7·74 |
| | | | | lb. oz. | | | lb. | lb. | |
| 8 2 | 6 | 4 | 7 6 | 78 13 | ·132 | ·66 | 9,416 | 9,976 | 23·17 |
| 8 2 | 6 | 4 | 7 6 | 38 11 | ·065 | ·32 | 2,696 | 3,156 | 15·31 |
| 8 2 | 6 | 4 | 7 6 | ... | ... | ... | ... | ... | ... |
| 4 $2\frac{1}{8}$ | 3 | 2 | 3 9 | 10 12 | ·061 | ·435 | 2,464 | 2,464 | 24·56 |
| 4 $3\frac{1}{4}$ | 3 | 2 | 3 9 | 4 15 | ·03 | ·13 | 560 | 672 | 13.42 |

The tube placed first in each series, is intended to be proportional in every leading dimension, as distance between supports, breadth, depth, and thickness of metal,—and any variations are allowed for in the computation. Thus the three first tubes of each series are intended to be similar; and in the same manner of the other tubes, &c.

Looking at the breaking weights of the tubes varying only in thickness, we find a great falling off in the strength of the thinner ones; and the values of $f$ show that in these—the thickness of the plates being ·525, ·272, ·124 inch—the resistance, per square inch, will be 19·17, 14·47, and 7·74 tons respectively. The breaking weights here employed, do not include the pressure from the weight of the beam.

The value of $f$ is usually constant in questions on the strength of bodies of the same nature, and represents the tensile strength of the material, but it appears from these experiments that it is variable in tubes, and represents their power to resist crippling. It depends upon the thickness of the matter in the tubes, when the depth or diameter is the same; or upon the thickness divided by the depth when that varies. The determination of the value of $f$, which can only be obtained by experiment, forms the chief obstacle to obtaining a formula for the strength of tubes of every form. When $f$ is known the rest appears to depend upon received principles, aud the computation of the strength may be made as in the Application de la Mecanique of Navier, Part 1st, Article IV.; or as in Papers of my own in the Memoirs of the Literary and Philosophical Society of Manchester, vols 4 and 5, second series. I have, however, made for the present purpose, further investigations on this subject, but defer giving them till additional information is obtained ou the different points alluded to in this report; and this may account for other omissions.

In the last table of experiments the tubes were devised to lessen or to avoid the anomalies which rivetting introduces, in order to render the properties sought for more obvious. Hence, the results are somewhat higher than those which would be obtained by rivetting as generally applied.

The tube 31 feet 6 inches long, 24 cwt. 1 qr. weight, and ·272 inch in thickness of plates, was broken by crushiug at the top with 22·75 tons. This tube was afterwards rendered straight, and had its weak top replaced by one of a given thickness, which I had obtained from computation; and the result was, that by a small addition of metal, applied in its proper proportion to the weakest part, the tube was increased in strength from 22·75 tons to 32·53 tons; and the top and the bottom gave way together.

If it be determined to erect a bridge of tubes, I would beg to recommend that suspension chains be employed as an auxiliary, otherwise great thickness of metal would be required to produce adequate stiffness and strength.

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REPORT OF COMMITTEE OF THE FRANKLYN INSTITUTE TO THE SECRETARY OF THE TREASURY OF THE UNITED STATES ON HUNTER'S SUBMERGED WATER WHEEL.

To comprehend the construction and action of Hunter's submerged wheel we have only to imagine an ordinary paddle-wheel, moviug at the side of a boat round a vertical instead of a horizontal axis, with the paddles attached to a water-tight and empty cylindrical drum, and the whole immersed below the surface of the water. If placed entirely in the open water, it is evident that the revolution of a pair of such wheels would produce no motion in the vessel, since any two opposite paddles must exactly counteract each other. That the boat may be propelled at all, therefore, it is necessary that the greater part of the paddles be made to revolve in dead water, by surrounding them with a casing of wood or iron. A very few—three or four—of the outside paddles are thus rendered efficient in the propulsion of the vessel, while all the force required to move the others through the water is wasted. This propeller, therefore, differs, in its action from the ordinary side wheels of steam-boats, only in the circumstance that, in the latter, the inefficient paddles move through the air, a medium presenting slight resistance,—while, in the former, the inefficient paddles move through water, a medium of great resistance. It is perfectly manifest then, that the latter must require a vastly greater power than the former to produce the same effect.

The Loper propeller is one of the many varities of the screw propeller,—an arrangement which, in some of its forms, has been long since devised and employed for driving vessels through the water, and which possesses the advantage, so important in many cases, and especially in war vessels, of being submerged under the water. As a comparison of the Loper propeller with others of the same class, is not asked of the committee, it is not deemed necessary to describe its peculiarities in this report.

For a simple and perfectly satisfactory comparison of the relative merits of the two propellers in question, the best test is that which would be offered by their respective operations if attached to the same vessel, and set in action by the same engine. Such a comparison is fortunately presented by a series of experiments made with the U. S. steamer *Spencer*, the details of which are given in the printed reports of Captain Alexander V. Fraser. As the vessel and engine were the same in both cases, it is not necessary that they be described; since, for a mere comparison, it is the variable quantities only that need enter into the computation:—

*Steamer "Spencer," with Hunter's propellers.*—In a trial made in New York bay, in September, 1844, with Hunter's submerged wheels attached to this vessel, it appears from Captain Frazer's report, that she moved through the water with a speed of 6·5 miles an hour. Now the work accomplished, in the propulsion of a vessel, for a given time, is proportional to the resistance offered by the water, and to the distance passed over. But the first of these is known to be, in such cases as the present, sensibly as the square of the velocity, and the second is evidently as the velocity itself. Therefore, the whole work done is proportional to the product of these two, or to the cube of the velocity. Consequently, in the present case, this is the cube of 6·5, or 274·6. The power exerted by the engine in doing this work is proportional to the effective pressure of the steam, and to the number of strokes of the piston in a given time, or it is proportional to the product of these two variable quantities. Now, in the example in question, the pressure of the steam (as indicated by the safety-valve, and therefore to be increased by one atmosphere) is reported to have varied from 75 to 80, or to have avaraged 77·5 lbs. to the square inch; and the steam was cut off at one-third of the stroke of the piston. From these data, the mean pressure in the cylinder is estimated at 64·54, and the effective pressure, after deductions for friction, according to the formula of Pambour, at 41.86. The number of revolutions of the engine (or of double strokes of the piston) is reported to have been from 53 to 54, or to have averaged 53·5 per minute. The effective power of the engine (or rather of the engines, for there were two) was therefore proportional to 53·5 × 41·86, or to 2239.

*Steamer "Spencer," with Loper's propellers.*—In May, 1845, Loper's propellers were substituted in the *Spencer* for Hunter's wheels (the engines being the same and in the same condition), and experimental trips were made on the Delaware, and were witnessed by the Committee of the Institute. For the required comparison, the trip made on the 23rd of May, from New Castle, to the Delaware Breakwater, is selected. On this occasion, the mean velocity attained was 9·38 miles an hour, and consequently the labour performed is proportional to the cube of this number, or to 825·3. The average pressure of the steam was 49·09 (or more properly, by adding the atmospheric pressure, 49·09 + 14.70 = 63·79), and it was cut off at the half-stroke. From these data, the mean pressure in the cylinder is estimated at 54·03, and the effective pressure, after deducting friction, at 32·85. The mean number of revolutions of the engine was 44·45 per minute. The effective power of the engine was therefore proportional to 44·45 x 32·85, or to 1460.

*Comparison of the Results.*—From these results we find that the power exerted by the engine with Hunter's wheels, was to that with Loper's propeller's, as 2239 to 1460, or as 1 to 0·652; while the work done by the wheels was to that done by the propellers as 274·6 to 825.3, or as 1 to 3·005. Hence it appears that Loper's propeller does 3·005 times more than Hunter's wheel, with 0·652 of the power; and therefore, with the same power, would be ($\frac{3005}{652}$ = 4·6) four and six-tenths times more efficient. This is a very remarkable result; but it is one which should have been anticipated from the evident waste of power inseparable from the use of the Hunter wheels, and it shows that their further employment ought to be abandoned.

A change from the Hunter to the Loper propeller was also made in the U. S. steamer *Water Witch*, and opportunities of witnessing her performance with the latter propeller were presented to the committee, and full notes of the results have been preserved. But unfortunately, although this report has been long delayed for the purpose, satisfactory information has not yet been procured as to the performances with the submerged wheel, the essential element of the speed attained being so uncertain that it cannot be made use of for calculation.

By order of the Committee,
William Hamilton.

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## Art. —ANALYSIS OF BOOKS.

*Of the Health of Towns, as influenced by defective cleansing and Drainage, and on the application of the refuse of Towns to Agricultural purposes.*—By W. A. Guy. M.B., Professor of Forensic Medicine, King's College. Renshaw.

This is a very interesting digest of the evidence which has been adduced before the Health of Towns' Commission. We have on former occasions referred to the valuable facts elicited before the commission, and to the necessity for their undergoing a popularizing process before the public mind would be sufficiently alive to the importance of the question. The contents of the pamphlet now before us, were lately given in the form of a lecture at one of the Metropolitan literary institutions, and have been published with the view of assisting in the great sanatory movement now in progress. The title of the pamphlet is indicative of the points of which it treats: these are the unhealthiness of towns as chiefly occasioned by defective cleansing and drainage, and the means of removing those causes of disease not only without expense but with a positive gain. In the treatment of these subjects no new facts are brought forward, for they have received so thorough an investigation at the hands of the commissioners, that nothing now remains but to present them to the public in striking and instructive form; and we shall transcribe a few of those facts in illustration of the subject. The unhealthiness of towns is proved by the greater mortality, which in 100,000 inhabitants in the large towns is 7,773 more every year than on 1,000,000 of the inhabitants of the country. The average duration of life also is less in towns; thus in Surrey it is 45 years, in London 37 years, while in Liverpool, which is notorious for its imperfect sanatory arrangements, it is only 26 years. All parts of a town however are not equally unhealthy, the mortality in the metropolis varying in different districts from 1 in 36, to 1 in 49, according to the imperfect cleansing and the over crowding of the inhabitants; the space per inhabitant being in the healthy districts 202 square yards, and in the unhealthy 32 square yards only. In the parish of St. Giles and St. George's, Bloomsbury, the dwellers in squares live on the average 40 years, while the inmates of blind courts and cellars live only 17 years; and in some parts of the metropolis the duration of life is even less. The injurious effects of imperfect cleansing and drainage have been well shown in Preston, where the streets which are well drained and cleansed have a mortality among children under one year old of 15 in 100, while in the worst drained streets it amounts to 44 in 100. All doubt as to the in fluence exerted by the emanations from decaying matter upon the health of the inhabitants must disappear when it is known that wherever improvements have been made in the drainage and cleansing the morality has diminished. In certain streets in Manchester which were paved and sewered, the deaths fell from 495 to 432 aunually; and in Ancoats a similar improvement was rewaded by a diminution of 40 deaths out of 270. A more striking case is that of Windmill-court, in Rosemary-lane, where, by flagging and draining the court and giving a constant supply of water, four or five months elapsed with only two cases of sickness; which, in the previous seven months, there had not been less than forty-one. It is from such neglected districts that the fever hospitals are filled; and, indeed, pestilence has always haunted them, whatever shape it might assume. The decaying organic matters which are so destructive to life may, if turned to use, become instrumental in supporting life; and, instead of being the occasion of expense to the community, be made to yield pecuniary advantage. The contents of sewers, it is well known, contain the elements of plants; and if this were doubted, chemical analysis and actual experiment will prove it. At present, the only refuse of towns which are used for manure are the contents of cess-pools and ash-pits, and the sweepings of roads. The sewers, however, contain a much larger quantity of more valuable manure, including salt, and the soaps and alkali's which are used for household purposes, the refuse of slaughter-houses, markets, and manufacturers. The riches thus thrown away amount, annually, to as much fertilizing matter as would supply an acre of wheat to each person.—The value of the contents of sewers has been exhibited at Edinburgh, where, by irrigation with sewer-water lands which were worth from 30*s.* to 6*l.* an acre now fetch from 30*l.* to 40*l.*; poor sandy land on the sea shore which had been worth 2*s.* 6*d.* an acre is now worth 15*l.* to 20*l.* The best mode of using the contents of sewers seems to be in dilution, the distribution being effected by means of pipes and a hose. In conclusion, for we can spare no more space for this subject, the annual loss from deaths and sickness which might be prevented, and from allowing valuable manure to run to waste, is estimated at 40,000,000*l.*; and it becomes an important subject for the consideration of the legislature how to save this almost incredible expense, which produces no benefit, and presses hard upon a struggling people. We think that much good must arise from the popular discussion of this subject by such men as Dr. Guy, althobgh we think that there is too evident a tendency to puff certain sewage speculations, and we are especially gratified at finding that Lord Ebrington has taken an active part in diffusing sound information on the subject of sanatory improvements. Such benevolent efforts for the advancement and improvement of the people are the most effectual preservatives of an aristocracy.

## Art. THINGS OF THE DAY.

### FINE ARTS.

*Meeting of the Art-Union.*—The annual general meeting of this association has lately been held in the Theatre-royal, Drury-lane, for the purpose of receiving the report of the committee, and distributing the prizes. The Duke of Cambridge in the chair The secretary read the report, from which it appeared that the total amount snbscribed for the year was 16,500*l.* or 1100*l.* more than in the preceding year. The report went on to state that the works of art selected last year had amounted to 278, and the committee had commissioned, on the part of Sir Erskine Perry, the execution in marble of Mr. W. Calder Marshall's group, "The First Whisper of Love." The committee, with the view of encouraging sculpture, offered the sum of 500*l.* for a group or single figure in marble, not less than 4 feet 6 inches high, to be competed for by models furnished in plaster. The models were required to be sent in by the 1st of July next, and the work completed in the same day in the following year. Beyond the selected group, it was hoped that others might be found suitable for casting in bronze. The bronzes for the current year, after Mr. Foley's "Youth at the Stream," were nearly ready, and would be distributed after the allotment. The engraving due to the subscribers of 1844, "The Castle of Ischia," was delivered in May last. The engraving for 1845, "The Convalescent," after Mr. Mulready, had been delayed by the indispositiou of the engraver, Mr. Doo. The subscribers had, however, the series of outlines by Mr. Rimer, illustrative of "The Castle of Indolence." The engraving due to the subscribers of the present year, "Jepthah's Daughter," engraved from the painting by O'Neil, was finished, and would be speedily sent to press. A series of outline engravings, illustrative of "Gertrude of Wyoming," would also shortly be distributed, in addition to the last-mentioned print. For the ensuing year, a pair of engravings, by Mr. C. Rolls and Mr. F. Heath, after pictures by Mr. Urwins, R.A., "The Last Embrace," and "The Neapolitan Wedding," were nearly completed; and the committee had also, with a view to future arrangements, placed in the hands of Mr. Lightfoot, Mr. Frost's "Sabrina," to be engraved, and they had also obtained permission from Mr. Maclise to engrave his prize cartoon of "The Spirit of Chivalry." For the premium of 500*l.* offered by the committee for the best original picture illustrating British history, twenty-eight cartoons had beeu sent in, and after due consideration the committee decided that the author of the cartoon "Qüeen Philippa Interceding for the Lives of the Burgesses of Calais," was best entitled to receive the commission, provided he were found competent to execute the painting. On opening the letter accompanying the cartoon, the artist was seen to be Mr. H. C. Selous, to whom the committee had awarded a premium in 1843, for his illustrations of "The Pilgrim's Progress." The painting, when completed, would be engraved for the Society.

*Stained Glass Windows.*—We are glad to fined that the beautiful art of painting or staining glass for windows is receiving extensive encouragement, so that there is every prospect of its assuming an important position among the arts, and firmly establishing itself in the public favour. In some cases lately glass windows have been introduced into churches, as funeral monuments, and the practice is to be commended, provided only that the designs and colours are made to harmonize with the building.—A new stained glass window has just been placed in the church of Lostwithiel, in Cornwall, by Mr. William Westlake, in memory of his deceased wife. The extension of the practice will secure this kind of decoration, for even the humblest churches and the public taste will benefitted, provided only that a proper power be exercised by those in authority, to secure a consistent uniformity, and a tolerable degree of excellence in the design.—A stained glass window, by Bell, of Bristol, has been presented to St. George's church, Tiverton, by Miss Walker, of that town. The subject is St. Andrew with the cross.—At Ely Cathedral, another new stained-glass window has been put up in the north transept during the week, the gift of the Rev. E. B. Sparke. The subjects are the Stoning of St. Stephen, and the Conversion of St. Paul. Also, within the last few days, the interior of the great western tower has been thrown open, restoring much beautiful work, and workmen are now employed in removing stone-work, to shew the zig-zag mouldings of the original arches that support the tower.—A stained-glass window, stated to have cost 700*l.*, subjects, the Resurrection and Ascension, has also been added to the decorations of King's College Chapel, Cambridge, by the Rev. W. A. Carter, Fellow of the College, and Assistant-Master at Eton.

*Sculpture by Machinery.*—An American paper states that a machine has been invented by a Mr. Thomas Blanchard, of Boston, for copying sculptures. By this invention, nature, art, everything tangible, can be copied, with a precision which defies the chisel, even when guided by the most skilful hand, and directed by the most gifted talent. The machine, too, can be graduated so as to give reduced copies of any statuary which shall, in their miniature, be perfect and exact copies of the originals in everything else but the size; preserving every line, furrow and dimple, and giving prominence to muscles and veins, and every particular lineament and feature, in exact proportion. By the same machinery the most correct and perfect bas-relief profile likenesses may be cut, on the hardest material, and of any size required, from half an inch to full-life size.

*Summary.*—Professor Willis has been engaged in delivering a series of lectures on the subject of ecclesiastical architecture. In the first part of the course, which is historical, reference is made to the pagan temples, the arrangements and construction of which grew out of the ritual of the worshippers; with ours, being so different, new arrangements were required. Although, however, the devotional sentiment is well expressed by the architecture of the middle ages, he believed that the same expression might be conveyed by pagan architecture. He thinks that the Roman basilicas were not granted to the Christians for transformation into churches; and from the destruction of Christian churches during persecutions being mentioned, it seems more likely that they built such places as they required in au unpretending style. He thinks that the transept originated with the Christian churches, and that so far from copying the heathen temples, they intentionally differed from them. The reverence of relics seems to have originated in the respect for deceased individuals, causing the erection of chapels in the disused stone quarries which sheltered the early Christians, which finally led to the erection of different chapels and altars even in the same church. The veneration for places caused the erection of shrines in the various parts of the holy land. Some of these places were probably identified, but many were assigned as the scenes of the parables which came to be received as actual narrative. The church of the Holy Sepulchre, which was raised by Constantine, or, perhaps, the Empress Helena, was one of the earliest and most interesting of these shrines: it was afterwards destroyed by the Persians, and repeatedly rebuilt and extended. The church of Santa Sophia, at Constantinople, was erected by Justinian, who exulted in its fancied superiority over the temple of Solomon. Th.s church, which is now a mosque, and has served for a model to the Moslem, failed in the foundations, and the great dome was at length overthrown by an earthquake, but was reconstructed with some alterations.—At a late meeting of the Freemasons of the church, Mr. George Isaacs delivered a lecture on ancient glass as applied to domestic purposes. After alluding to the arts of forming and colouring glass vessels among the Egyptians, Mr. Isaacs explained the nature of their manufacture, and described many of the finest known specimens in existence. Following the art through the histories of Tyre, Sidon, and Etruria, he proceeded to the period of Greek art, on which he dwelt at some length, adverted then to the Portland vase, some specimens in the Bibliotheque Royale, and those exhibited at the last meeting by the Earl of Cadogan, in all of which examples, it seems conclusively demonstrated that the glass was blown of two colours, viz., of deep purple coated with white, and that out of the exterior surface were carved those exquisite bas-reliefs, which, from their extraordinary delicacy and precision, have been an enigma to antiquaries of considerable authority. A wonderful specimen of Greek art, in the possession of Mr. Herly, was then described, having a series of gold figures burnt in from the interior of the vessel, and some curious historical information was given on the subject of malleable glass from Dion Cassius, Petronius, Arbiter, and Isidorus, Ibn Abd Alnolm, Nero, and many other writers. The composition of malleable glass was said to have been discovered in France some months ago, and various paragraphs appeared in the public journals announcing the discovery, but latterly nothing has been heard upon the subject. The removal of the excise duty, however, will cause the manufacture to advance with giant strides. —The marble statue of his Royal Highness Prince Albert, subscribed for by the merchants of the city of London, and intended to adorn the vestibule of Lloyd's, at the Royal Exchange, is completed. Its execution was entrusted to Mr. J. G. Lough, who, it will be recollected, was also selected by her Majesty to execute her statue that now graces the merchants' area. The fine group of the 'Burial of the Princes in the Tower,' by the poor young sculptor, Shenton, has been purchased, we are given to understand, by a tasteful patron of art, H. Chawner, Esq., of Newton Manor House, a relative of the deceased sculptor.—A handsome entrance-gate to Magdalen College has just been completed from the designs of Mr. Pugin. It consists of a central gateway, and a small doorway to the Porter's Lodge. The style of architecture is that of the period of Henry VI.; and the details are copied from examples to be found in the original portions of the College buildings. The doorway is highly enriched, having shields in the quatrefoils of the spandrils, on which are emblazoned the lines of the College arms, and the badge of Henry VI., painted upon copper. In a string-course of lilies is sculptured in old English characters, William of Waynflete's motto, "Fecit mihi magna qui potens est." Over the gate, within a beautifully decorated niche, is an elegant figure of St. Mary Magdalen; and in niches in the buttresses on each side of the gateway are figures of St. John the Baptist, and William of Waynflete; the former holding a lamb in his arms, and the latter in his pontificals, holding the model of a church in his right hand, and his crosier in his left.—We learn from Weimar, that the Grand Duke is about to restore and embellish the celebrated Castle of Wartzburg, in Thuringia, to which so many interesting memorials of the private life of Luther are attached. In excavating for the repair of the foundations, the workmen have discovered a series of eighteen columns in the Byzantine style, and a variety of other objects of middle-age origin.—The Art-Union is at issue with the government respecting the legality of lotteries, for the purpose even of promoting the fine arts. The Chancellor thinks that cabinet-makers are equally entitled to the privilege of selling their wares by lottery; whereat the friends of the Art-Union are shocked.

CONSTRUCTION.

*Arrangement of Kitchens.*—We lately visited the kitchen of the Reform Club, and we must say we have never seen anything so admirable as the arrangement and management of the kitchen of that establishment. Fire grates for spits, hot plates, ovens and other calorific contrivances are arranged in the most convenient and judicious modes, and although there were so many persons employed there was nothing of the nature of confusion. One arrangement struck us as being applicable in other situations —we refer to the method of cooking by gas. The gas comes up through a layer of pumice-stone in pieces, the size of a walnut, lying over a cross gas-pipe, pierced with holes; and after the gas has been ignited it soon makes the pumice-stone red hot, and we have an excellent clear fire produced almost instantly. M. Soyer, the *chéf de cuisine* of the Reform Club, to whom most of the merit of these arrangements is due, is now completing a new work on his art, which contains plans of kitchens, to different dimensions, showing the arrangement of the necessary apparatus, and drawings of stoves and ovens in the kitchen of the Reform Club. The work cannot fail to be a valuable one to the architect and builder; for many of the improvements of the Reform Club are applicable to every class of dwelling.

*Market Places.*—A report upon market places by a public commission has just been published in Paris, which contains much interesting and practical information relative to those institutions. It has been drawn up on the occasion of a new market place in Paris having been projected, and the reporters are Messrs. Anger, Inspector-General of Market-halls of Paris; V. Ballard, architect; and A. Husson, chief clerk of the Perfecture de la Seine. Details are given by the commissioners on the markets of London, Manchester, and others. The inconveniences of Smithfield Market are justly described and censured in the following words:—"Who should believe that this immense metropolis has no exterior market-place for cattle? It is in the midst of the city, a few paces from the Cathedral of St. Paul, where a host of animals are driven to and sold. Smithfield is the *beau ideal* of disorders in the way of markets—the shifting of cows, bullocks, and horses; the peregrination of herds of sheep and swine; the escaping of half-furious beasts; the howling of dogs, shouting of drivers, screams of frightened passers-by—add to this, that the streets through which this world of beasts pass, are choked by this throng, and dirtied by their excrements. Whence comes all this inconvenience? It is because the corporation opposes its removal, leaning upon a statute enacted by Edward III.—*five hundred years ago.*"

*Insalubrious effects of Bad Drainage in Houses.*—The pernicious effects of imperfect drainage in houses have been clearly pointed out in innumerable instances in the evidence given before the Health of Towns Commission. Mr. Dyce Guthrie, to whom so much credit is due in connection with the introduction of tubular sewers, has lately multiplied these proofs still further; he has addressed a letter to the *Ayrshire Agriculturist*, drawing attention to the illness and death of various members of a family, in the neighbourhood of Noblehouse, which he shows resulted from defective drainage. Professor Christison, to whom the matter was referred,—great alarm having been excited by the mysterious nature of the occurrence,—says to Mr. Guthrie, in a letter referring to this case:—"I may mention, that before I saw you, I had come to an opinion, that the most probable cause of the disease at the farm-house of Stevenston, was impregnation of the soil around or under the house through defective drainage; and recommended that the state of the drains should be inquired into. In a report which was requested from me by the crown officers, I stated that such was the most probable view to be taken of the case; and my report had scarcely been delivered, when I received information that three drains in the house had been found so defective, as to be utterly useless for their purpose; that they had been choked up, and had never been cleaned out during several years, ever since the tenant, lately deceased, took the farm; and that an enormous accumulation of filth had been found on proceeding to clear them." It cannot be doubted that mortality has been greatly increased by the mysterious and subtle poison emanating from such receptacles.

*Plaster of Paris.*—At a late meeting of the Institute of British Architects a paper was read by M. Delassaux on a 'New Mode of Preparing Plaster of Paris in an Economical Manner for Solid Construction and for Plastering.' It appears that English plaster stone is a sulphate of lime, destitute of water, and containing but a small portion of sulphuric acid, being only fit for internal plastering; whereas the stone of the French plaster in the environs of Paris, is composed in the best proportions of acid and the bases; and when properly burnt, preserves its acid properties, and becomes fit for exterior decorations. Mr. Tite bore testimony to the large employment of plaster of Paris in France, where it is successfully used for external works; in Canada, too, it was employed, but in England it had been apprehended it would not answer for similar purposes, perhaps, in consequence of the presence of sulphuric acid in the atmosphere, arising from the general use of coal fires. M. Delassaux says, that he has made arrangements for supplying plaster of Paris in London, at 30*s.* per ton, whereas the present price is from 3*l.* 10*s.* to 4*l.* 5*s.* Twenty-six pounds of the plaster, costing 4½d., will cover one yard of wall, and two pounds of plaster, costing 5½d., will cover one yard of ceiling. Whether plaster of Paris be applicable or not to outside work in this country, it can hardly be doubted that the reduction in price must greatly extend its employment.

*Summary.*—Mr. Young the secretary of the treasury has given notice of his intention to introduce two bills, one of them relating to the new Royal park at Battersea, the other to the construction of an embankment on the north shore of the river, from Battersea-bridge to Vauxhall-bridge.—The first model establishment of Baths and Washhouses is now in progress of construction at Goulstone-square, Whitechapel, and is to be completed by the 24th of June. The building is to hold about 100 baths, and these are to be lined with an entirely new tile of white glazed ware. In the washing department the drying closets are to be made on a scientific plan, so as to insure not only the rapid drying of the clothes, but their thorough ventilation, and the destruction of all vermin which survive the process of boiling. —It appears from Captain Willis's police statistics, that the number of buildings on the 31st December, 1845, within the borough of Manchester, were 50,744. He classifies them as follows:—factories, 123; foundries 43; warehouses and workshops, 3,813; dwelling-houses, 41,606; shops used as dwelling-houses, 4,872; cellar dwellings, 5,385; places of worship 97; public schools, 106; military barracks 1; banks, 16; markets, 14; railway stations, 4; gas stations, 5; workhouses, 2; infirmaries, hospitals, and dispensaries, 7; night asylum, 1; lock-hospital, 1; penitentiary, 1; public institutions, 27. The cellar dwellings, being only portions of other dwellings are not included in the gross total.—The Society of Merchant Venturers of Bristol have withdrawn their Bill, the Water Works Company having agreed to pay certain expenses incurred by the former. The Water Works Company's Bill will probably pass immediately. It is greatly to be regretted that the whole of the Water Works in the kingdom are not brought under the control of the Government. Water, an article of such prime necessity, should not be made a thing of profit for individuals.—The foundation stone of St. Paul's Church, Hull, for the immediate erection of which builders have been invited to send in contracts, will probably be laid in the beginning of June.—The church of St. John the Evangelist, at Westmeon, has been consecrated by the Bishop of Winchester, with the customary formalities. The new church stands on an eminence at the entrance to the village, and was built chiefly at the expense of the late Ven. Archdeacon Bayley, who was for eighteen years rector of the parish. Its style is that which prevailed in the latter half of the thirteenth century.—Poole Harbour Improvement Bill, from non-compliance with some sessional order, has been lost for the present session.—In the *Gentleman's Magazine* Dr. Bromet recommends that a register of sepulchral brasses, incised slabs, and stained glass be kept by the incumbent of every church, and also suggests that every person who has made tracings or rubbings, might communicate a list of them to the magazine. Dr. Bromet also communicates the questions to be submitted to the French Architectural Congress, which will meet at Mentz on the 16th of June. The subjects are not merely antiquarian, but such as concern in some degree the future practice of architecture.—The windows of St. James's Church have been painted at the expense of Mr. John Malam, and the building has been cleansed, repaired, and altered, and its former defective ventilation much improved, by a few additional openings in the ceiling connected with apertures in the roof, by which the heated air is said to be now entirely carried off without occasioning any draught.—It has been stated that the foundation-stone of the building for the Sailor's Home at Liverpool, will be laid on the 30th of July, and that her Majesty will accompany his Royal Highness Prince Albert, to Liverpool on the occasion.—The foundation stone of a new Wesleyan College, has lately been laid in the Parish of Trull. The building, with its lawns and shrubberies, is to extend over a space of about six acres of land. Mr. Wilson of Bath is the architect; Mr. Mason of Exeter, is the contractor, and has undertaken the whole work for little more than 5,000*l.*—The new church of St. John at Wednesbury, has been consecrated by the Bishop of Lichfield during the past month. It consists of a lofty nave with side aisles, and a detached tower is built in the style of the 13th century, and is 130 feet in length, from the west to the extreme end of the chancel; and 53 feet in width. The principal features are the coupled lancet windows in the aisles, having foliated capitals between them; also a triple lancet window at the east end of an elevated chancel, and a nave 50 feet high with open roof and ornamental timbers.—It is stated that the decayed old church of St. Benedict, Lincoln, is to be pulled down, the bishop being engaged in an effort to unite that parish with the parish of St. Peter at Arches.—On the 1st of May the church of St. Philip Neri, at Barcelona, was inaugurated with a grand mass in music. It replaces an ancient chapel of St. Louis in the church of the Jesuits, specially appropriated in early days to the use of the French residents at Barcelona.—Mr. Barry has been surveying the church of Wimborne (Dorset) with a view to extensive renovation; Mr. Barry is, it is said, employed by the Attorney-general, with whom, for the present, the fund applicable to these improvements rests.—In Egypt when the works of the barrage of the Nile shall be completed, it is in contemplation to build on the spot a new town, to be called Mehemet Ali, and which is intended to rival Cairo in importance.—Lieut. Williams, R.N., one of the admiralty surveyors, has been engaged in surveying and sounding the estuary of the Ribble, to determine the best site for a lighthouse, and the best mode of lighting the entrance to the river. It is said that he will report in favour of a lighthouse to be erected at the Double Stanner, at the mouth of the Ribble, about three miles from Lytham.

RAILWAYS.

*Metropolitan Termini.*—Sir James Graham has instrucred the Metropolitan Terminal Commissioners that it will be their especial duty to consider whether the extension of railways into the centre of the metropolis is calculated to afford such additional convenience or benefit to the public as will compensate for the sacrifice of property, the interruption of important thoroughfares, and the interference with plans of improvement already suggested, which may probably result from such extension. The limits to which the attention of the commission should be confined may be thus specified, viz., the Edgware-road from Oxford-street to the intersection of the New-road; the New-road and City-road to Finsbury-square; Bishopsgate-street; London Bridge; High-street, Borough; Blackman-street; Borough-road; Lambeth-road; Vauxhall-road; Vauxhall Bridge; Vauxhall-bridge-road; Grovesnor-place, and Park-lane.

*Blaizy Tunnel on the Paris and Lyons Railway.*—Doubts having been lately expressed respecting the practicability of executing this tunnel, a French paper has sent a correspondent to the spot, who reports as follows:—I visited the works at Blaizy on the 3rd of May. Six hundred men were then employed in pumping water, and in fixing steam-engines at the mouths of twelve of the deepest shafts. It is true as alleged, that they have dismissed several superintendente, and a large number of workmen, but this was owing to the interruption of the works at shafts 8, 9, 13 and 15, where the water accumulated so fast that nothing but steam power would suffice to drain it away. They have also paid off the labourers who were employed at the entrances of the tunnel because the cuttings there are finished. To perverted accounts of these facts, if not to positive malice, must be attributed the reports which have gone abroad as to the abandonment of the tunnel. Nothing conld be wilder than this notion. The sinking of the shafts is already very far advanced; shaft 10 is already 100 metres (330 feet) in depth, which is upwards of two-thirds of the work; shaft 16 has attained a depth of 110 metres (383 feet), or nearly three-fourths of the entire depth; 17 is already finished, and 18 and 19 are nearly so; on the side towards the valley of the Oze the shafts are all in a state of forwardness. The masonry uecessary for setting up the steam-engines (which with their apparatus, have arrived), is completed, and is of a strong and solid character. The tram-road is nearly ready. M. Debain, a contractor of eminence, who executed the tunnels for the Marne and Rhine Canal, has declared his willingness to borne the tunnel, and was at Blaizy at the same time as myself, inspecting the works with a view to that enterprise; in a word, everything proceeds with a brisk activity.

*Iron Skew Bridge on the North British Railway.*—A bold an ingenious specimen of a skew bridge is now erecting on the line of the North British Railway, at the south foot of the Calton-hill, Edinburgh. It consists of six strong beams of cast iron, each composed of four or five pieces joined with rivets and cast in the form of an arch. They are about 80 feet long; the roadway from wall to wall is 26 feet broad, and has a narrow footpath on each side, at the outer edge of which cast iron columns are placed, supporting the beams at 10 or 12 feet from either extremity. The beams rest on their ends on solid masonry, and are fastened to each other by strong wrought iron bars running across them at right angles The angle of the skew is 20½ degrees.

*Barentin Viaduct.*—This viaduct over the Rouen and Havre Railway, the downfall of which we some months ago recorded, is again in active process of reconstruction. A correspondent of one of the French papers writes as follows:—I have just been visiting the Barentin viaduct. The new plans approved by government, are in the course of execution. The company acted wisely in adopting the radical measure of pulling down the old structure. Instead of the vicious system of rubble work *(bloccage)*, they now employ regular layers of hewn stone; these will be of large size, and built in by masonry of the strongest and most durable sort; the centres will be of brick. They have abandoned the idea of using wood work. Six hundred workmen are employed in the reconstruction. Nevertheless it would be in vain to hope that the line will be opened before the beginning of the next year. During this interval the directors will have ample time to see that the other works of art, such as the viaducts of Mirville and Malaunay, are as they ought to be. Sundry reports have gone abroad, bearing that they are in a weak and dangerous condition; but, as it appears to me, nothing can be falser. It is well, however, that the public should be satisfied. It should seem that the contractors of the company and the commission appointed by government are in perfect agreement as to the measures of consolidation and precaution to be taken in regard to this matter. At Malaunay the works are far advanced.

The *Nuremburg Correspondent* states that the works on the Saxon railways are satisfactorily progressing, and that the one leading to Bohemia will be finished as far as Pirna, in the course of the year. The same journal adds, that the Saxo-Bavarian line will in all probability be extended in the course of the autumn as far as Reichenberg.

Contracts have been accepted for the most important works on the Oxford, Worcester and Wolverhampton line, for the earth-works, bridges tunnel, &c., in Mickleton parish, near Broadwey; for a short tunnel near, Worcester, and for the bridges, tunnel, &c., at Dudley, and amongst the inghgbour neicoal mines.

*Summary.*—The traffic on German railroads is thus given by a German paper. The 36 German railroads (covering a space of 416 geographical miles) conveyed last January 760,232 persons, and 1,848,447¾ quintals of goods. The total receipts amounted to 656,408 5-6 dollars, which is equal to 51 dollars *per diem* and per mile. Against January, 1845, an increase is shown of 147,752 persons, 707,533 2-3 quintals, and 78,728 dollars; but on the other hand, there is a decrease of 81,747 persons, 214,673 quintals, and 95,118 dollars, in comparison with the month of December last.—It is currently reported that the result of Mr. Morrison's Committee will be the recommendation of the establishment of a tribunal to consider and report upon the incipient stages of private business—one, too, which shall have powers to suggest. The notion is not Mr. Morrison's.—The *Times* thus sums up the capital likely to be wanted for the bills, the preambles of which are proved:—the Irish railway bills read a third time in the House of Lords, 3,063,000*l.* English and Scotch railway bills, read a third time in the House of Commons, 10,982,000*l.* Total read a third time, 14,045,000*l.* Preambles of other Irish railway bills proved in the House of Lords, 9,686,082*l.* Preambles of other English and Scotch railway bills proved in the House of Commons, 15,929,809. Total, 25,615,891. Grand total of capital for which preambles have been proved, 39,660,891*l.*—The Midland Railway Company has purchased, for 6,000*l.*, a site for the station at Lincoln, for the Nottingham and Lincoln line.—The Direct Northern Company caloulate on saving 20,000*l.* at Bassingthorpe, where they expected to have to construct an expensive tunnel. Upon boring, instead of rock, they at present find nothing but clay, which will consequently make it a mere cutting. The rumours had been rife, and are now confirmed, that this company has amalgamated with the London and York.—The works of the first division of the Dublin and Belfast Junction line, from Drogheda to Dunleer, have been commenced, and the second division, from Dunleer to Dundalk, will shortly be placed in the hands of the contractors, thus affording employment during the present season of distress.—The labourers on the Dorchester and Southampton railway, near the town of Poole, have commenced driving the piles preparatory to the construction of the bridge at Rockley Point, over the entrance to Lytchett Bay.—A correspondent of the *Daily News* states, that in the first 20 miles of the Caledonian railway, north of Carlisle, little or nothing has been done excepting the mere staking out of the line and breaking ground. At Lockerby, 24 miles from Carlisle, the works are commenced in earnest, and already hills have disappeared, and high embankments rear their heads. From Lockerby to Mid-Annandale very great progress has been made, and many miles of the line are in a forward state.—The telegraphic communication between Nottingham and Derby is eompleted. and that from Nottingham to Leicester is in formation. From Leicester the wires are to meet those at Rugby, and so on to London; all along the line workmen are now actively engaged. The various station-masters have been apprized that they will shortly receive the working apparatus; so that telegraphic communication will soon be complete between London, Liverpool, and York.—Upwards of 900 labourers are at work upon the Great Southern and Western railway in Ireland, near Maryborough, on contract No. 5. The line is formed and ready for the sleepers within a mile from Portarlington. The Nore viaduct, in the Trummera and Clonard district, is nearly completed.—It is stated that the projected Halesworth and Norwich line of railway will cut directly through the remarkable Roman fortification at Caistor, the ancient Venta Icenorem, near Norwich. A deviation in the line might, it appears, have been made without materially affecting the cost.—The young quicksets along the London and Birmingham Railway have undergone a new method of training. Instead of being allowed to grow perpendicularly, they are inclined in the direction of the line. This has been done from London to Rugby; and the cost of so simple an operation has exceeded 5,000*l.*—The cost of the valuable report on the guages was 571*l.* 10*s*,—The French Government having charged the chief engineer of the department of the Rhone to assemble a commission, and proceed to an inquiry into the causes of the accident which happened on March 1, on the St. Etienne and Lyons railroad, the engineer who acted as president, has transmitted a report, from which it appears that the engine which broke down had been long iu use—that the rails to a considerable extent were in a bad condition—that the curves were too sharp—and that the diligences were upon the old structure, without springs, and consequently unfit to sustain shocks.—The bridge across the Seine on the Paris and Rouen line, has proved trustworthy; and the inauguration ceremouy of its completion took place lately, the Bishop of Evreux pronouncing a bencdiction.—A Rio Janeiro journal speaks of a project for establishing a translantic communication betwen Liverpool and Para, by means of steam: from which latter place it is intended that boats of less power and dimensions shall asscend the river of the Amazons, as far as Bolivia; while a railway shall cross that country to Africa, on the Southern Sea.—Mr. Bain has contrived a plan for securing a uniformity of time at all the railway stations throughout the country. This he accomplishes by connecting the pendulum of one of his electrical clocks by a wire, to the works of a common clock at another station, by which means the beats are identical. This contrivance has, we understand, been tried between Edinburgh and Glasgow, and has succeeded.

## ENGINEERING.

*Manufacture of Steam Engines.*—At present the manufacturers of locomotives throughout the country have more orders on hand than they can possibly accomplish at the required early delivery, and they will not enter into fresh engagements for a less term than two years. The average price of a locomotive is about 1,800*l.*, but it is expected shortly to be 2,000*l.* The following engines have been ordered at the principal engineers:—Stephenson, 224; Sharp, 196; Hawthorn, 70; Nasmyth, 60; Forster, 80; and Fairbairn, 35. In France and Belgium, the directors of the new companies have the greatest difficulty in obtaining their locomotives, rails, and the necessary material to carry out the lines, which causes a considerable delay in their accomplishment, and which, there is little doubt, will ultimately lead to the introduction of British machinery and iron at a moderate duty.

*American Atlantic Steamers.*—It appears, from the American papers, that a company has been formed in the United States to run steamers across the Atlantic, and that a contract has been concluded by it with the American Postmaster-General for the carriage of the mails. Two vessels will be ready, it is said, by the 1st of January, and 1st of February next, and the other two by the 1st of July and 1st of August following. They are expected to cross the Atlantic in favourable weather in ten days. The two first completed are to be commanded by Captain Mowitt, commander of the Havre packet-ship Utica, and Captain Morgan, of the London packet-ship Victoria. The following are some of the chief dimensions:—Length of keel, 230 feet; breadth of beam, 38 feet; depth of hold, 24½ feet; and 1,700 tons burthen each. They are to be constructed in the most substantial manner, and in every way suitable for ready conversion into war steamers or steam-frigates, if required. The engines are of the following dimensions: cylinders, 75 inches in diameter; stroke, 10 feet; boilers, 12 feet shell and 35 feet long, with return flues. The paddle-wheels will be from 35 to 50 feet in diameter, and 7½ feet broad.

*Spanish War Steamer Blasco Garay.*—This is a steam vessel recently built by the Messrs. Wigram, of Blackwall, for the Spanish government. The following are the principal dimensions:—Length between the perpendiculars, 137 feet; extreme, 209 feet; breadth between the paddle boxes, 31 feet 11 inches; depth of hold, 20 feet; mean draft of water with the machinery, 10 feet 6 inches; tonnage, 915. All her arrangements and fittings, cabins, store-rooms, magazines, &c., are those of a war-steam frigate of the third class in the British navy. Her armament is—two eight-inch swivel guns, 68-pounders, and 4 32-pounders. The engines are by Messrs. Miller, Ravenhill, and Co. An account of them will be found among our Notes of the Month, in the present number. The *Blasco Garay* has recently been tried on the river and has been found, we believe, a satisfactory vessel in every respect.

*Fracture of a Fly Wheel.*—The spinning and weaving-mill of Messrs. Mellor, at Ashton, in which between two and three hundred men are employed, was recently brought to a stand still by the fracture of the fly of the engine attached to the mills. It appears that the accident arose from the hands in the dressing-room throwing their machines out of gear, a short time previous to the usual hour of stopping, by which the engine having its load suddenly diminished, went off at a greatly increased speed, and the centrifugal force acquired by the fly wheel was so great that it flew into fragments which tore up the engine-house floor, fractured the iron entablature beam, and broke through the second floor and the roof of the building. Fortunately the masses in their flight through the engine-house inflicted no injury, as no work is carried on above the engine, and the engineer who was hurrying in at the engine-house door, although knocked down, received no serious hurt. The engine must have either been without a governor, or the governor must have been ineffective in its operation, otherwise such an accident could not have taken place.

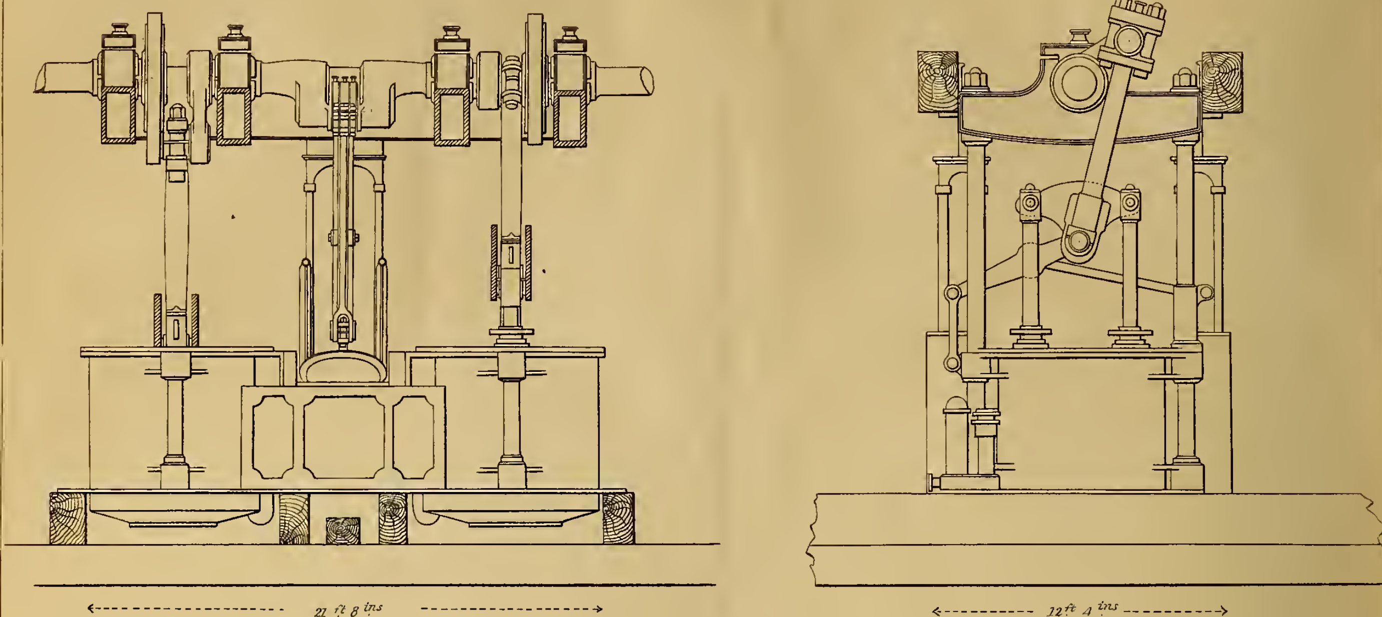
*The Great Britain.*—The *Great Britain* has again started for New York. She has been under the hands of Messrs. Maudslay and Field, and is said to be much improved in speed and in various sea-going qualities. The masts—which had been made capable of falling back upon the deck,—and the wire rigging, have been removed; and the vessel has been furnished with new masts stepped upon the keelson, and fitted with rope rigging after the usual fashion. One of the six masts too has been taken away. The propeller remains of the same diameter as before—15 feet 6 inches, but it is now stronger and better made. The engines are better supplied with steam than previously with a less consumption of fuel, and the speed of the vessel is materially increased. In an experimental trip, made on the 30th of March, the *Great Britain* beat the Cork steamer *Nimrod*, and the mail steamer *Prince*, about an hour; and she held way for about half an hour with the fast new iron steamer *Sea-King*. The highest speed with steam alone was 11⅔ nautical, or about 13½ statute miles per hour, the engines at the time making 16¾ revolutions per minute.

*Prize Essay on Steam Navigation.*—At the sitting of the French Academy of Sciences lately held for the announcement of the prizes, the prize of 6000f., founded by Baron Charles Dupin, when in the Ministry of Marine, for the best work on the most advantageous employment of steam in navigation, and the best system of mechanism, &c., was not awarded, none of the essays having given satisfaction. This prize, which was first promised for 1836, but has never yet been awarded, is postponed till 1848. A Montyon prize of 2000f. was awarded to M. Chaussenot for his improvements in the floats and valves of steam engines.

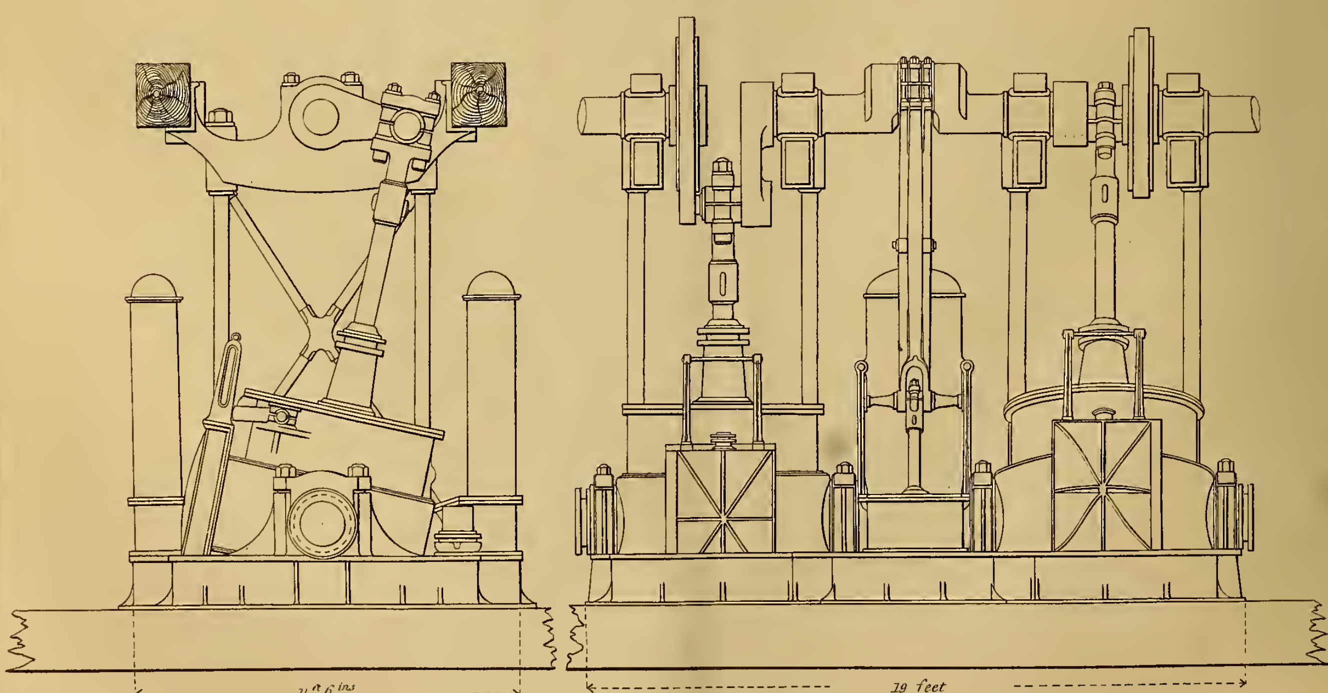
## MISCELLANEA.

The number of fires that have taken place in the metropolis and its suburbs, since the commencement of the year, according to the records kept by the brigade authorities, amounts to more than 300. The loss of life is, happily, not so great as formerly, which is attributed to the judicious course pursued by the Superintendent of the Force, in providing every constable of the Metropolitan Police with printed instructions for his guidance on discovering fire. The most important injunction is, that of keeping all doors and windows closed until the arrival of the brigade-men and engines.—There are no fewer than eleven steamboats on the Thames, engaged in the traffic between London and Westminster bridges alone, at one penny the trip, making 32 trips in the hour, or 320 trips per diem, which, taking 40 as the average number of passengers each journey, will make a total daily of 15,000, whilst the return number may be estimated at the same amount. The fares are one penny, making in round numbers £125 as the daily receipts; and the time occupied between the above points varies from a quarter to half an hour, being a much shorter time than it can be effected by omnibus.—The repeal of the duty on glass, which led to the employment of this substance for pipes for the conveyance of water, has been succeeded by its use for milk pans, which are not only much more easily cleaned than metal, but may be scalded without any fear of fracture.—A Plesiosaurus, the length of which is supposed to have been from 25 to 30 feet, has lately been discovered in a railway cutting now in progress at Woodhouse, near Ely. Unfortunately the navigators in their ignorance broke to pieces the head, neck, and trunk, but one of the paddles, and about ten feet of the tail, have been preserved.—In excavating for foundations to the houses about to be erected in front of Maud's-hill-terrace, Lincoln, great numbers of stone coffins and human remains have been found. The site is that on which the battle between King Stephen and the Empress Maud was fought.—A letter from Copenhagen, of the 16th of April states, that the eruptions of Mount Hecla continued to be very violent. The flames which issued from three great craters attained a height of 14,400 feet, and their breath exceeded the greatest breath of the river Picersen, the most considerable river in Iceland. The lava had already formed lofty mountains, and among the masses of pumice-stone vomited by the volcano, and which have been found at a distance of three-fourths of a mile, there were some which weighed half a ton. By the eruption of Hecla, the enormous quantities of snow and ice which had accumulated for several years on the sides of that mountain have been melted, and partly fallen into the river Rangen, which has overflowed its banks several times. The waters of that river, which runs almost at the foot of Mount Hecla, and which receives a large portion of the burning lava, were so hot that every day they cast upon the banks numbers of dead trout, almost half baked. The cattle also are poisoned by the ashes which have fallen.—A writer in the *Gazette des Hospitaux* insists that the Electric Girl is the victim of St. Vitus Dance in a somewhat aggravated form, and that the existence of this malady explains the phenomena which have incontestibly been observed in her case.—In France speculation seems on the decline, and is turning more to works of industry, and particularly iron-works and coal-mines. The impulse given to iron-works generally by the demand for rails, chairs and locomotives for the lines in course of construction, has produced much profit, which is daily increasing. New iron-works are being established by shares, but the best of these undertakings are those long-established who have sunk a portion of their capital, which they now require to work with to supply the wants of the times.—In the year 1671, on the second reading of a bill in the House of Commons, for building a bridge over the Thames, at Putney, after a number of members had delivered speeches in ridicule of the idea, Sir Henry Herbert, just before the House divided, rose and said—"I honestly confess myself an enemy to monopolies. I am equally opposed to mad visionary projects; and I may be permitted to say, that in the late King's reign several of these thoughtless inventions were thrust upon the House, but were most properly rejected. If a man, sir, were to come to the bar of the House and tell us that he proposed to convey us regularly to Edinburgh, in coaches, in seven days, and bring us back in seven more, should we not vote him to Bedlam? Surely we should, if we did him justice; or, if another that he would sail to the East Indies in six months, should we not punish him for practising upon our credulity? Assuredly, if we served him right."—The London Committee for promoting the establishment of baths and washhouses, have petitioned Parliament to pass a law, empowering boroughs and towns to establish such, and to impose moderate rates to defray any excess of expenditure over income.—The *Dublin University Magazine* states, that the Shannon falls 147 feet from Lough Allen to Limerick, the last fifteen miles from Killaloe presenting a difference of level of not less than 97 feet. The power from Killaloe to Limerick is something above 350 horses power for every foot of fall, making for 97 feet 33,950 horses power. With the exception of a few corn-mills along the river, this force is allowed day after day to go to waste.—The official *Gazette* of Coblentz notices the arrangments recently agreed to between the Prussian and Dutch commissioners with respect to the navigation on the Moselle. For the future no customs or ship dues will be required from vessels going *in transitu* on the Moselle, beyond Schengen, or on the Rhine, beyond Coblentz.—The works for the manufacture of glass, on the eastern bank of the river Hull, are in a state of great forwardness, and will, probably, be in operation at Midsummer.

*Direct Acting Engines constructed by Mess.rs Rennie, for Her Majesty's Steam Frigate "Bull Dog."*




*Oscillating Engines constructed by Mess.rs Rennie for Her Majesty's Ionian Packet "Oberon."*




F. Mansell sc.

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# THE ARTIZAN.

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## Art. I.—THE GAUGE QUESTION.

The gauge question is settled so far as the government is concerned. The Board of Trade instead of confirming the recommendation of the Gauge Commission that all future railways should be on the narrow gauge, has made an exception under certain conditions in favour of the branches or continuations of the Great Western railway, and parliament has listened to this flagitious counsel and sanctioned the perpetuation of a great national grievance. What the broad gauge party want in argument they appear to make up in political finesse, and whatever be their other talents they incontestibly possess the talent of setting off their case to the best advantage, and of using with effect those arguments by which many members of parliament will most probably be swayed. But the arts of diplomacy unfortunately do not wear, and truth will in the long run prove stronger than all the powers of persuasion. Though the Great Western directory may win over the Board of Trade they will find it a harder thing to retain the allegiance of their own shareholders; and at a meeting of the Great Western Company held at the very moment of victory, the chairman was able only to obtain a reluctant and conditional consent to the extension of the broad guage into Wales; and it is yet uncertain whether the extension will be permitted. The truth is, the Great Western railway by its obstinate adherence to the broad guage has set all the other railways in the kingdom against it and placed itself in a condition of imminent peril. A narrow guage railway will probably be run into the broad guage districts since the Great Western refuses to promote the desired uniformity, and public opinion would certainly be in favour of any such undertaking. If this be done the Great Western will be a ruined compauy. It will find itself completely isolated; the current of intercourse will stagnate, and all the adroitness of Mr. Brunel and his backers will be insufficient to conjure back the golden stream. This danger the shareholders in the Great Western Company are already beginning to apprehend. They are beginning to see, too, that whatever reason Mr. Brunel may have for clinging to his crotchet apart from all consideration of its operation upon the company he serves, *they* have no reason to signalize themselves by so blind an adoration.

The evils of a break of guage are undisputed; and although many ingenious plans have been contrived for transferring the carriages of a broad guage on to a narrow gauge line, no one we believe maintains that they would be as satisfactory in their operation as a uniformity of gauge, while the prevailing opinion among the best authorities is, that all such ingenuities are impossible in practice. Uniformity of gauge therefore appears to be indispensable to the full development of the railway system; and although Mr. Brunel enlarges on the advantages of the broad guage for the sake of competition, yet we hardly conceive that he would esteem it a benefit that every branch of the Great Western Railway should be on a different gauge for the sake of competing with the rest: and if it be desirable that the same gauge should obtain in all the branches of a railway, it is equally desirable that the same guage should obtain in all the railways of a system. But if a uniformity of gauge be demanded, and the merits of the systems be supposed to be equal, it is clear that inasmuch as 1900 miles of railway have been constructed on the narrow gauge, and only 274 upon the broad gauge, the narrow gauge is the one to be retained, as it involves least alteration. The broad gauge moreover can be transformed into the narrow gauge by merely shifting the rails, whereas to transform the narrow gauge into the broad would involve the construction of new tunnels, the widening of bridges, and the performance of other works that would equal in cost at least half the expense of a new line. If no railways had been hitherto constructed on either guage probably a few inches additional width of gauge would be of some advantage; and on a former occasion we expressed ourselves in favour of a five feet gauge which under such circumstances would perhaps be preferable. But to these few inches of additional width we do not attach much importance. The engine can be adapted to the gauge instead of adapting the gauge to the engine; and the gauge of four feet eight and a half has been found to be perfectly adequate to the present wants of the country, and possesses capabilities yet unfathomed. It is no doubt true that the locomotive capabilities of the broad gauge are greater than those of the narrow; that is that a larger current of intercourse can be transmitted through it. It is equally true that the locomotive necessities of the country must increase every year. But the anticipation of such an increase is no justification of the formation of broad gauge lines, as the number of railways will increase also, probably, in an equal proportion; so that the traffic of each will in all likelihood remain much as it is at present. The argument of foresight, therefore, which the advocates of the broad gauge have paraded with so much ostentation, fails them as completely as all the rest. They have incurred a certain present expense for the sake of a future advantage in the case of main trunk lines that will never be realized, while, as regards branch lines, the system will not bear a moment's examination; for if the main trunk lines be of needless power for the exigences of the time, what must the branch lines be?—and as the branches of a railway must always be on the same gauge as the railway itself, the ultimate ramifications of a broad gauge line must either be of greatly superfluous power, the expense of which excess ultimately falls upon the public, or else the tracts of country lying near the line must be deprived of the benefit of railway communication which, if the narrow gauge were universal, they would enjoy. Mr. Brunel endeavours to shew in his evidence before the Gauge Commission that the broad gauge is not perceptibly more expensive than the narrow gauge, but his arguments on this head are too trivial to need refutation. Seven feet of tunnel, bridge, or embankment must clearly cost more than 4 feet 8½ inches, and although in the Great Western railway the embankments do not materially exceed in width those of the London and Birmingham line, in consequence of the narrowness of the space left outside the rails, yet the contraction of this space is not a question of gauge, and the peculiarity introduces other dangers. We need not dwell, however, among the small plausibilities with which Mr. Brunel seeks to extenuate the adoption of the 7-feet gauge. We shall presently lay before our readers a summary of the whole of his evidence given before the Gauge Commission, and they can separate the wheat from the chaff for themselves if they think the benefit worth the pains.

The broad gauge had its origin in a misconception. It had long been supposed by engineers that the piston of a steam engine could not travel beneficially at a greater speed than 200 feet in the minute, which was the speed employed by Watt in his condensing engines. Mr. Brunel appears to have concluded that the same restrictions as regards speed, which was obtained in the case of the condensing engine, existed also in the case of the high-pressure engine, and he therefore proposed to make the piston of his engines travel at a moderate velocity, and to bring up the speed by the use of large driving wheels. The large wheels, however, he found would raise the centre of gravity too much, unless the base were extended, and he therefore widened the railway to permit the use of the large wheels. Several engines with driving wheels ten feet in diameter were constructed, some of which we inspected in the factory of Messrs. Hawthorne, on the occasion of the meeting of the British Association at Newcastle. The cylinders were large, and were placed on a separate carriage from the boiler, and the cylinders communicated with the boiler by means of a pipe furnished with a ball and socket joint.

These engines, however, on being tried, did not prove successful. It was a work of much difficulty to start or stop them, they were more liable than ordinary engines to run off the rails, and were altogether so troublesome, cumbrous, and dangerous, that they had to be discarded. But what was to be done with the railway? It could not be discarded with the same facility; and Mr. Brunel had then to set his wits to work to discover advantages in the broad gauge that were previously unsuspected. In this he has been so successful that he has persuaded others, and perhaps even himself, that those advantages existed. Time, however, will dissipate these airy imaginations. Two fallacies cannot make a fact, and Mr.

Brunel will yet learn by a painful retribution, that a persistence in error only multiplies its penalties. Physical effects are too palpable to be capable of maintaining a perpetual delusion. They must only tell their own story in language all can understand, and bring the confirmation of proofs which none can gainsay. In the light of such revelations the faith even of the most confiding must wax faint and expire. The worshippers of the genius that has dazzled the crowd by its corruscations will bow before it no longer; and instead of a pillar of fire to guide their footsteps, they will regard it as a dangerous meteor, or an *ignis fatuus* that is leading them onward to destruction. Genius in engineering is a dangerous qualification, unless there co-exist with it a calm and ripened judgment to restrain its excesses. The shallowest judgments and the most ardent imaginations are always the most remarkable for their adventure; and innovation which has such an origin is always the most dangerous. Engineers of genius are not to be trusted until they have learned to distrust themselves; and it does not manifest much diffidence on the part of Mr. Brunel, that in the first railway with which he ever was connected, he introduced innovations which the most experienced engineers have refused to imitate. Our business, however, is not with Mr. Brunel, but with the gauge question, and we proceed to introduce to our readers a summary of the evidence given before the Gauge Commission, by Mr. Robert Stephenson, which is to the following effect:—

*Robert Stephenson, Esq.*—Witness's father, Mr. George Stephenson, was chief engineer of the Manchester and Liverpool Railway, completed in 1830. The gauge of 4 feet 8½ inches was adopted by his father, as it was the original gauge of the railways about Newcastle. The Manchester and Liverpool was the first line in this country worked by locomotive engines. After the Liverpool and Manchester had been established, it was considered imperative that all the lines in that neighbourhood should be of the same gauge. It is difficult to say where a break of gauge in the northern lines could have been made with the least inconvenience, as it involves the question where is the line of minimum traffic.—When travelling on the Manchester and Liverpool Railway, before laying the gauge of the London and Birmingham, it appeared to witness, as an engine-builder, when called upon to construct engines of greater power, that an increase of three or four inches in the gauge would have assisted him materially, but since, the improvements in the mechanism of the engines have rendered that increase quite unnecessary; they have ample space and to spare. In the arrangement of the machinery, which is the main question, having reference to the width, the working gear has been much simplified, and the communications in the most recent engines between the eccentric and the slide valve have been made direct communications; whereas formerly they were made through the intervention of a series of levers which occupied the width. With reference to the increase of power, the size of the boiler is in point of fact the only limit to the power, and they have been increased in length on the narrow gauge; the power is increased by increasing their length both in the fire-box and in the tubes; in fact, the power of the engine, supposing the power to be observed, may be taken to be directly as the area of the fire-grate or the quantity of fuel contained in the fire-box. No inconvenience results from lengthening the engines to their present extent, and their steadiness is increased; they are at present 12 feet between the front and hind axles. The increase of length between the axles renders the engines less liable to get off the rails; the short engines on four wheels were liable to violent oscillations when meeting any inequality, the front wheels being sometimes actually lifted off the rail; believes the accidents on the Brighton line and on the Brentwood inclined plane were attributable to this pitching motion. The thickness of the crank of the original engine on the Manchester and Liverpool was 3½ inches. There were various plans of reversing the engine at that time. Every engineer, in fact, at that time, had his own plan; some were extremely complicated, requiring time for the reversing to be effected; they moved, in fact, the eccentric, which slipped upon an axis, and thereby moved from one side of the axle to the other, and consequently reversed the engine; but it required a lateral motion of something like 3½ inches; and there being two eccentrics, of course the mere act of changing the gear occupied 6 or 7 inches of the axle independent of the more bulky construction of the apparatus itself. The long engines, if kept within 12 feet, are not more likely to get off the rails at curves than short ones. The resistance in passing round curves is materially affected by the width of the gauge, being indeed as the square of the guage. In the collieries about Newcastle, where the 4 feet 8½ gauge prevails, wherever they come to any mining operations where the power to be used is that of a horse or man, they immediately reduce their gauge, because they want to go out and in amongst the mines with very sharp curves, and the wide gauge would be quite impracticable amongst those. In fact, the small carriages that are used in the mining operations are upon a gauge of about 20 inches, and they go round curves under ground of about 10 or 12 feet radius; and they could only work such mines by such a gauge. It is quite obvious that the width of the gauge must limit the curve. In the case of every gauge at a sharp curve, the outside and the inside rail are quite brightened by the sliding motion, because the one set of wheels has to slide forward to keep pace with the other, and the others have to slide backward. In fact, when going round a curve, both operations have to take place,—the sliding backward of the one set and the sliding forward of the other. Of course, as you increase the width of the gauge, the difference between the two becomes augmented.

Is chief engineeer of the Northern and Eastern Railway, and was at its construction. Adopted the 5 feet gauge in consequence of its being brought into connection with the Eastern Counties line, which had been laid down with that gauge by Mr. Braithwaite, and with the same view laid down the 5 feet gauge on the Blackwall, in case there should be connection between them hereafter. The gauge of the Northern and Eastern and Eastern Counties lines has recently been altered under his direction; when the extension of the Northern and Eastern was considered, and that junction with the narrow lines in the Midlands would take place, a change was thought absolutely necessary, and the same change was also decided on for the Eastern Counties, from the inconvenience of blending two gauges at the Shoreditch station; the expense of a separate carrying establishment would have been greater than the cost of alteration, which was £52,000. Of course, it involved the necessity of working upon a single line of rails; the establishment was divided into two parts, one of which was retained as available for the 5 feet gauge, whilst the other half was altered to be ready to work upon the other line, which had been converted into the 4 feet 8½ inch gauge, therefore the alteration from one gauge to the other was to take place in one night, in fact, between the two trains, the last at night and the first in the morning. The whole distance was 88 miles. The operation occupied about six weeks altogether, but preparations were made beforehand. The alteration was made entirely under his superintendence, and the rails being on transverse sleepers facilitated it materially. No new rails were required, and the boilers being of the same size as those on the 4 feet 8½ inch gauge, the engines could be converted.

Considers it would be advisable to run the same carriages from Euston-square to Edinburgh and Glasgow, were a railway complete. There are men at different stations to see that nothing is wrong, and the carriages, both for passengers and goods, are now so substantial that they may run many thousand miles without anything but greasing. Goods wagons go at less velocity, and would probably stand it better. The carriage is now much more judiciously constructed than formerly. The strength of carriages conduces very much to safety in case of accident, and the plan of making the under frames of carriages of wrought iron instead of wood, will be carried out to prevent the harm at present done by splinters. Is projecter of the Chester and Holyhead Railway, and will use the 4 feet 8½ inch gauge, that carriages may run from Euston-square to Holyhead; any change would interfere with communication to Ireland. His father and he were consulted as to the lines from Antwerp to Brussels, and from Liege to Ostend, and he was connected with the Leghorn and Pisa, and recommended the 4 feet 8½ inch gauge, as it had been found in this country to answer every purpose. An inch or two, more or less, would have involved a different construction of engines, and he saw no reason for altering that which had been established by experience. Was consulted on the Belgian Railways and on the Leghorn and Pisa. When giving his opinion as to the Belgian lines, the Great Western was not opened, but in reference to the Italian line he had seen both gauges in operation.

Is not aware of any advantage the Great Western possesses, and it has several disadvantages; the additional expense of construction, as in embankments, cuttings, tunnels, bridges, and viaducts, and also in carriages, engines, tenders, workshops, and stations, everything being on an increased scale. The sliding-frame system has to be introduced instead of turn-tables, so that the management of the station is more expensive. Thinks the tear and wear of the carriages on the Great Western in as much as on the narrow lines, and the resistance of the wide carriages is greater; there is more friction of the wheels on the rails to be overcome. The increased expense of the carriage department on the wide gauge would not be in the haulage per mile, but in the fixed establishment of engines. Even the increased boiler (4 feet 9 inches) of the Great Western would as nearly as possible go into the narrow gange.

While he thinks the Great Western has no advantages by the wide gauge, its introduction has involved the country in great inconvenience; if a meeting of gauges takes place in the midst of great traffic, canals would have a decided advantage over railways; the system of boxes and loose-bodied wagons for the transfer of coals has been tried and failed. The loose-box system involves the necessity of increasing the number of carriages, on the railway very materially. At Erewash the coal-owners could not avail themselves of the railway, and sent the coals by canal. Coal-owners would prefer transferring their coals from railway to canal to moving them from one railway to another, on the loose box-system, as by the latter they would lose control over their boxes; they would prefer the transfer by hand, from one railway to another, to loose boxes. The American railways are universally of the 4 feet 8½ inch gauge. There is a railway from Basle to Strasbourg of 6 feet 3 inch gauge, but parties there deeply regret the alteration, as they look forward to a transfer at each end. There is a line laid down by Deridder, from Ghent to Antwerp, of 3 feet 9 inch gauge. He has seen at the Paddington terminus the modes proposed to supercede the necessity of removing goods and passengers at the junction of different gauges, and believes it would answer the purpose as far as machinery could, but seeing one or two transferred does not convey the amount of inconvenience incident to transferring 100 coal wagons. The other mode of transferring by running the train on another set of trucks, would increase the dead weight to be drawn, so as to be highly objectionable, and the increased height would prevent some classes of goods from getting through the bridges and tunnels. The London and Birmingham goods-wagon, properly laden and placed on the Great Western truck, could not pass under their bridges. The expedient at the Great Western terminus for diminishing and widening their gauge of wheels may be safe, but being complicated, he thinks it would not keep in good order; it would also be an expensive arrangement. A modification of the sliding axle was tried on the Newcastle and Carlisle, and soon abandoned. He has not been able to think of any expedient to avoid a transfer; he has seen various ones contrived; the one by Mr. Harding, of the Bristol and Gloucester, is as good a mechanical expedient as any, but that would be so objectionable as to lead to the actual transference of goods in preference. An arrangement at the Birmingham termini for lifting goods-wagons from one level to another is the simplest operation, but if they had to be put on different wagons, the evil would be very much aggravated; even with regard to Birmingham, the inconvenience of the lift is so great, that it is to be abandoned, and an inclined plane substituted.

Is still a locomotive engine-maker, and is of opinion that the 4 feet $8\frac{1}{2}$ inch guage gives ample space to get the utmost power necessary for working ordinary trains; at present there are, he believes, more powerful engines working on the narrow than on the broad-gauge lines. The cylinders of those engines are 16 inches in diameter, the length of stroke is 24 inches, and the wheels vary from 4 feet 6 to 4 feet 9 in diameter. They are all six coupled; and those engines are as heavy as the present rails will bear. They weigh from 22 to 23 tons; I believe the same weight as the Great Western engines. There is now as great a weight upon six wheels upon the narrow gauge as ought to be put upon 6 wheels; and that will be hereafter the limit of power, not the width of gauge; engines may be built upon the wide gauge, no doubt, heavier and larger in dimensions, and more powerful, but then you must make a road to support it on purpose. The weight of the rails is 75 pounds to the yard, 65 have been used. The width between the bearings varies from 3 ft. to 2 ft. 9. Thinks the narrow guage lines best calculated for carrying weight without injury to the road, and the transverse-sleeper system is better for keeping the rails in order than the longitudinal bearings. The expansion and contraction of the iron tend to disturb the action of the sleepers, as shown on the Peterborough line, where the rails had been laid too close, and acted on by the heat of the sun, raised the sleepers three feet into the air. Locomotives can be manufactured for the narrow gauge capable of attaining as high velocities as those on the broad; they are now running upwards of 50 miles an hour, with engines not made for maximum speed. No difficulty in making a narrow-guage engine to take 40 tons at 60 miles an hour, or more; the engines on the Great Western were made for greater speed, but the average on it was the same, or a little under the Northern and Eastern. The average speed of the Great Western is greater than on the London and Birmingham, except for mail trains, which are precisely alike. Has worked the express trains on the narrow line with as much economy of coal, &c., as on the Great Western. The express engines on the Birmingham are smaller than others, weighing only 12 or 13 tons, and costing about £1300. Should recommend those weighing 17 or 18 tons, and costing about £1650. Thinks the public safety would be endangered by having the bodies of the passenger carriages moveable at a change of gauge; any slight collision, not otherwise dangerous, would throw them off, besides the risk of porters neglecting the fastenings of each. Would never incur the responsibility of having the bodies separate from the under frames, as, besides other objections, the under frames would be more liable to derangement. The complexity of the broad and narrow gauges in the same station would be great; the turn-table, a most invaluable machine must, be abandoned. Combining two gauges, by laying the rails of one centrally within the other would get rid of some of the difficulties, but not at all stations. Turn-tables would be used, but already in the wide-gauge system they are beyond the pale of turn-tables, from the distance between the fore and aft axles of wagons.

In changing from a narrow to a broad-gauge line, believes the least evil is to transfer everything, changing the carriages and moving the goods by hand; with reference to general merchandize, has heard Mr. Brunel express the same opinion. Thinks it would be better to have two rails for the narrow laid within those of the broad gauge, than to have only one, and to use one of the broad gauge rails; as in the latter way, the two trains could not accompany each other, the centre of gravity not being on one line. If the engine were at the head of the trains, it would be of less consequence than if they were propelled from behind. A double system would be required to drive each carriage from the centre, and this is a matter of serious expense. Witness would lay down the narrow within the broad gauge on the transverse sleepers, and the cost would be about £4000 a mile, or more, in addition; Mr. Brunel estimates a single line additional at £2,500, besides the extra cost of station. This is on the supposition that the broad gauge is first laid down on transverse sleepers, but the expense would not be materially different in either case. The rails would not be packed well with longitudinal sleepers on both systems. In adding a pair of rails within the broad gauge, witness would lay down the transverse sleepers independently; for with other longitudinal sleepers, there would not be room for another balk like the present, and the ballast of the weight would not be in the centre. Could not mix the systems of sleepers, on account of the length of the transverse, which would almost cut the longitudinal in two. It would be impracticable to lay down the broad on the narrow gauge, without sacrificing one line in tunnels, which would, from danger, amount to a prohibition. On the narrow gauge 24 feet are required for tunnels, and on the Great Western 4 feet to 6 feet more. Four feet is the minimum space between the two, just room for a man to stand, and the same space at each side o the tunnel, and any diminution would be fatal. Recesses might be made at intervals to meet a diminution, but a man might not be near a recess when the train came. Recesses could be made after the tunnel is formed, but in many cases the brick-work would thereby be much injured. Impossible to place the broad gauge on the London and Birmingham, withou enlarging the tunnels, and closing the line for two or three years. Would rather make a new one, than enlarge the present Kilsby tunnel. A cutting could not be kept open there, and it would be a gigantic work. With reference to the present and future meeting of the broad and narrow gauge lines, does not apprehend much interruption to the express and other passenger trains at the points of junction, if they are made at the proper places; thinks Bristol and Oxford two places where the two gauges ough to meet, as at these two points he believes there is the least quantity o cross traffic.

The principal Midland Counties traffic, from Rugby to the Great Western, supposing the double line were constructed from Oxford, would be coals going towards Oxford, and corn coming back. Looking to Southampton as the port. it would only require, supposing the narrow gauge carried down to Oxford, a line from Oxford to the South-Western to complete the narrow gauge system over the kingdom, as far as Southampton is concerned; the Great Western Company have a line from Reading to Basingstoke, and if that were laid on the narrow gauge, and the double system from Reading to Oxford, there would be no break in the country at all; commercially, Southampton, London, Bristol, and Liverpool would interchange with each other, and with the manufacturing districts, by the same carriages. No extension of the wide gauge towards the London and Birmingham would relieve Lancashire or Yorkshire from a change of gauge, but an extension of the narrow from Oxford to Basingstoke would relieve the whole question of embarrassment. The Great Western Company can be compelled to lay down the double gauge from Rugby to Oxford, and on the greater portion from Wolverhampton to Oxford, and to Worcester, as they agreed to do that. The loss of time in transferring a passenger train at Rugby to go to Oxford on the broad gauge would depend on the amount of passenger traffic; it is a point of small passenger traffic; it may be a large one of coals and corn; the extension of the wide gauge into that district must multiply the points of junction of the two gauges, and the chances of interruption: passenger trains could not be changed in less than half an hour. Has experienced the inconvenience of changing carriages, and scrambling for luggage on the Belgian railways at Malines. Was detained the last time about half an hour. If the change of gauge took place at Rugby, a new station would be required.

With regard to agricultural traffic, at any point of change, the beas would require to be grazed before removing them from one carriage to another, and is afraid the loose bodies would be required for pigs; they could not be managed otherwise; they must be lifted *en masse*. The wagons themselves upon the narrow gauge vary from 2 tons 10 cwt. to 3 tons; some recent large ones run as far as 3 tons 10 cwt., and they will carry 5 and 6 tons of goods. I think the latter is as near two to one as possible that is, that if the dead weight is one, the useful weight is two The difference is here against the broad gauge; the trucks for intermediate traffic seldom average more than a ton each, so that all the intermediate traffic on the Great Western is carried on with trucks of 5 tons, with one ton of goods in them. As railways extend into every corner of the country, the advantages of the narrow gauge would be most apparent, and as the wide is more expensive than the narrow, the former would limit the ramifications of railways. The narrow gauge wagons are infinitely superior for mineral traffic, particularly coal; if the mixed gauge system be allowed to extend in this country, the charge on coal will amount in many cases to a prohibition. Thinks the broad gauge has a disadvantage as to horse-boxes; their motion is sometimes fearful; they want length with reference to their width, while on the narrow gauge a carriage of the same length might be very steady. Prefers the narrow gauge passenger carriages, carrying three in width, to those of the wide, carrying four; the latter are cold in winter, and want ventilation in summer. There has not been so much attention paid to the construction of the narrow gauge passenger carriages as to the broad, but the narrow could be made 6 feet high, so that a person might stand up in them. The least longitudinal distance between the axles of 4 and 6-wheeled engines on the narrow gauge, is 10 feet, and the highest 12 feet 9 inches; the last are too long; witness adopts a maximum of 12, and a minimum of 10 feet; relatively the centre of gravity is the same height in both gauges. Though there would be great difference as to the cost of constructing the broad and narrow lines, cannot say there is any difference in the cost of working. Whether the traffic be much or little, it is merely a question of expenditure of power, and though the most powerful engine is cheapest to work with a proportionate load, each may have engines of the same power.

The wide gauge engines are not more powerful, but are heavier in proportion to their power; everything in the width gives the engine no power at all, but is an encumbrance. Neither commercially nor mechanically has the wide gauge any advantage over the narrow but rather the contrary. The driving wheels of the broad gauge engines are not generally of greater diameter than the narrow; 6 and 7 feet engine wheels are used on the Great Western. The greater diameter of the driving wheels has a tendency to reduce the axle friction; but comparing 6 and 7 feet, the amount of this is not worth measuring, but if by increasing the gauge, the axle has to be increased in size for strength, what is gained on the one hand is lost on the other. The friction of the flange of the wheels against the railway has a retarding effect on curves, but not much on straight lines. Any lateral friction arises from the angle of the wheel against the line, and must be greater on the wide than the narrow gauge; round curves the sliding motion must be directly as the width of the gauge.

The evaporating power of a passenger engine, on the Northern and Eastern, is about 130 cubic feet an hour; he has some evaporating 160 feet. The most powerful engines are constructed with either outside or inside cylinders; the largest are inside. Some engines with outside cylinders have more of a yawing motion and lateral friction on the rails. It is exceedingly difficult to say how the motion is produced; if you consider the action of the cylinder, it is perfectly rigid metal—engine and cylinder altogether. Now, when the steam presses upon the piston, it is at the same time pressing against the lid of the cylinder; the action and reaction must be equal. Therefore, it is not the steam that causes the irregular action, but the mere weight of the pistons themselves, and therefore, if we could contrive to balance the pistons by weight upon the wheel, we should get rid of that very much; in the most recent designs of engines of that kind, he has brought the cylinder much nearer to the driving-wheel, and nearer to the centre of the engine; at present they hang over the wheels a good deal; now he has brought them within the wheels.

It is not an indispensable part of the broad gauge system to use the longitudinal bearings; it a question of expense. As you increase the width of the gauge, of course, on the longitudinal system, it leaves the expense the same; whereas, if you adhere to the transverse system, you increase the size of wood, and you increase the expense more rapidly; therefore the transverse system with a very wide gauge would be very objectionable on account of its expense, but he thinks the principle of construction would be better. With reference to the maintenance of the way, imagines that the way is kept in better order upon the transverse system than upon the longitudinal at the same expense; has never seen any portion of longitudinal bearing railway in perfect order. It is more difficult to pack, and there is always more friction in a longitudinal railway than in a sleeper railway. The Hull and Selby is part of it longitudinal and part of it transverse; affording a good opportunity for testing the comparative merits of the two systems, in point of economy of construction and efficiency in working. The engines, where they were heavily laden, upon the longitudinal bearings would just creep along; the moment they got to the transverse bearings they went 5 or 6 miles an hour more directly. Does not think that in that case it resulted from the longitudinal bearings being of insufficient dimensions and slighter than the Great Western, thinks they were the same size; —Memel balks, 12 or 14 inches square, cut up; and the Great Western are 14 inch balks. In the longitudinal system there is a little less noise, and there is a little softer motion than upon the transverse system, but there is a great deal more actual motion upon every longitudinal railway than upon the transverse sleeper system.

If the London and Birmingham had originally been made on the broad gauge, estimates that it would have cost about £3000 a mile more, without including the additional cost of the central station at Wolverton, which must have been much larger. As to altering the existing gauge on the London and Birmingham, thinks as it would stop the line for at least two years, that it is practically impossible. It would cost about £15 a yard for tunnelling, taking good ground and bad. To make the Kilsby tunnel as large as the Great Western tunnels, it would have cost a great deal more than that. On the other hand, in increasing the size of the tunnel in good ground, such as chalk, the additional cost would not have been so much. States the results of experiments, showing the consumption of fuel and water, by an engine with different load. Found that the consumption of fuel for drawing the engine without a load, was equal to about the consumption of fuel to overcome a load of 15 carriages at 30 miles an hour; that is, it took as much to move the engine and tender as it did additional to move 15 carriages. There have been many reasonings upon that without considering the precise application of it. A large proportion of the fuel in moving the engine alone is consumed in overcoming the resistance of the atmosphere to the pistons; it will not require more than three or four pounds to overcome the friction of the engine and tender proper, but it requires 15 pounds in addition to that to overcome the engine and tender, taking into account the atmospheric resistance to the piston; so that there is always 15 pounds of pressure of steam in all high-pressure engines absolutely lost; it is not the friction of the engine; certainly it is a defect in the engine from its being a high-pressure engine, but on no other account. It is not a peculiar loss applicable to locomotive engines alone, but to all high-pressure engines; and therefore in estimating the consumption of fuel and dividing the proportion of expenses, it became important to ascertain what was the relative expense of conveying 8 carriages, and of conveying 15, because all the trains of the Croydon Company were small, and all the trains of the Dover Company were comparatively large; and from this experiment it appears that as to the cost of coke, whether to convey 8 carriages or 15, there is a very small difference. Therefore, if you proportion your expenses by the load, you give the small load very greatly the advantage, because you charge them only half the fuel, say as 8 is to 15, whereas you ought to charge them as 8 plus the engine is to 15 plus the engine, which will make a very great difference.

Believes the gauge of the Dutch railways, constructed in 1842, to be 6 feet 5½. The Amsterdam and Haarlem Railway is essentially level, and laid on longitudinal timbers, which are best suited to the unsound ground of Holland. The line laid over Chatmoss is laid on transverse sleepers, but the moss there has much more tenacity than the substratum of peat in the low part of Holland. Mr. Conrad constructed or projected the line in Holland; he examined railways in this country, but does not know whether he was assisted by any English engineers.

We now come to Mr. Brunel's evidence, of which the following is a summary:—

*Isambard Kingdom Brunel, Esq.*—Is the engineer of the Great Western Railway; the line was surveyed under his direction in 1833, being three or four years subsequently to the formation of the Manchester and Liverpool Railway; before he took the direction of the Great Western Railway he had no other employment in railway matters. It was the first line upon which he was engaged as an engineer which was constructed; had looked over other lines of country with a view to railways. It occurred to him that change of gauge would be desirable in the course of his surveys in 1833 and 1834, the trains at that period were lighter than they are now, both in goods and passengers. Had determined upon submitting the 7-feet gauge to the directors of the company after the passing of the Act in 1835; mentioned it to the directors long prior to that time. Communicated with Lord Shaftesbury upon the subject early in 1835; the specific gauge has been omitted in all railway acts since. If he had to re-construct the line should rather be above than under 7 feet. Considers it of advantage to have not only a heavier and a more powerful engine, but also an increase in all the parts of the great machine of the railway system. Looking at the quantity of goods and passengers, the number now carried, and which will most probably be greatly augmented, and considering also the speed at which it is thought necessary to carry them, believes the parts of the machinery would be better if they were rather larger. Should economise in engine-drivers and stokers by having one engine to do the work of two. The first cost of the same amount of power is less in ten engines than in fifteen; looks rather to the efficiency of the result of the working of the whole machine, than as a mere question of economy in the first cost of the machinery. Assuming the masses to be moved to be from 60 to 80 tons for passenger trains, and between 200 and 300 tons for goods trains, at 50 or 60 miles an hour for passenger trains, and 30 for goods trains, has no doubt that to carry those weights at those speeds efficiently it is better to have larger carriages, larger waggons, larger wheels, and more powerful engines, than those which hitherto have been used. This opinion applies not only to the broad gauge lines, but also to the general system, but not for lines with much less traffic. The important lines of England, and a large proportion of the mileage of the whole railways of England, will have a very large traffic upon them, and will be worked at very high speeds. Assuming that all great lines will be provided with railways, and that railways will gradually take the place of turnpike roads in England, he still should be of opinion that there will be a very large traffic upon them, and that upon a very large proportion of them, which must still be the main lines of the country, this traffic would be sufficiently large, and the speed sufficiently high to justify the adoption of the principle just laid down. The Great Western was the first long line laid upon the longitudinal system of sleepers. The other system had been blocks and transverse sleepers. The difference of expense between longitudinal and cross sleepers is very small; from having no experience on a large scale in the laying of rails with cross sleepers, could not give the details of prices, but can give all the details of the longitudinal. The quantity of timber is greater with longitudinal bearings, but as it admits of lighter rails, the quantity of iron is rather less. The laying is easier with the longitudinal system than with the other. Should think the cross sleepers and rails will be a little the cheapest. The cost of the construction of Great Western is greater than the London and Birmingham, or any other narrow gauge line. The embankments and cuttings on the Great Western are not wider than the London and Birmingham, but the latter have the advantage of a greater width between the rails. Part of the difference in the case of the Great Western is caused by the increased width of way each system of railway occupies in addition to the increased gauge. It is impossible to fix the proportion of expense caused by increased width in cuttings and embankments; it depends upon the extent of work; in heavy embankments and in heavy cuttings the difference is small, the slopes forming the larger portion of the quantity of work. In bridges, and the greater number of works connected with a railway, the actual increase is very small. The wing walls of bridges underneath the railway form a very large proportion of the total quantity of masonry, and they remain the same on both gauges. In bridges over the railway the wall remains the same except the arch, and whether the arch be 28 or 32 feet does not make much difference. The increase is most considerable in tunnels, being fully in proportion to the increased width, and perhaps a little more. The increased expense of tunnels is not directly proportionate to the increased width, because a vast number of the expenses of tunnelling are independent of the question of the mere quantity of excavation which is effected; the increase of masonry would not be in the ratio of the increase of the breadth, but there would be an increase caused by it. The drainage remains the same in both cases, and all the contingent expenses remain nearly the same. The timber for a 30-foot arch, ought to be a little stronger than for a 26-foot arch, but practically, all the contingent ezpenses remain the same. The expense of land is very slightly affected, and no difference in the question of severance or damage to property. The fences remain the same in both cases. In respect of stations, taking surface for surface the broad-gauge stations are less for the same convenience, because the amount of surface covered by the carriages is rather less per passenger. The length of platform is considerahly less; the actual surface required for carriages sheds, and for all the contingencies of stations is if anything less. Assuming it the same, the length of trains, and therefore the length of platforms, which materially affects the extent of station room, is less than with a narrower guage, in about the proportion of 3 to 4. This proportion is again a little reduced from the use of six-wheeled carriages, but that has nothing to do with the question of guage. The whole of the carriages upon the Great Western Railway are six-wheeled carriages. Is of opinion that the three axles and three pair of wheels conduce very much to public safety. Is also of opinion that engines with six wheels tend more to the safety of the public than those with four wheels, irrespectively of all other dimensions. Is now constructing engines of greater power and greater weight upon the Great Western Railway with a view to greater speed. Considers the present express speed quite consistent with the public safety. All things considered, does not think there is much difference in respect of safety between the speed attained on the mail train and the express train. A speed of 60 miles an hour involves some increased danger over 40; but that increased danger is met by increased precautions, and, all things considered, the express trains are as safe as the others. More precaution is taken by all parties concerned at the stations and other places for fast trains than would be necessary for slow trains, there is a better selection of carriages; the more the speed is increased the more careful they necessarily become in the construction and in the state of the carriages. With the express trains the engines are got into the highest possible order, and nothing is allowed to be open to risk, The express trains do not go quicker than the other trains. The other trains between London and Bristol will frequently in the course of the journey, and on the same gradient, be travelling as quick as the express train. The express train is more regular throughout the journey. The difference is not so great as to require a different class of engine for the one than for the other. Stoppages upon the other trains are so long, and so variable, that they are obliged to travel between the stations very frequently as quick as the speed of the express train, or they would not keep their time on the whole journey. The higher the speeds, the more desirable it is to have the permanent way in perfectly good order. Does not know of any great improvement wanted in the permanent way of any of the lines to enable them to run at high speeds. Orders are given to the engine drivers of the express trains to slacken the speed in going through those stations where there is a necessity for it; the smaller stations, of course, do not require this precaution. In all the principal Great Western stations there is a turn out of the direct liue. Men are stationed at the points to turn the train out of the line. Most attention is required in passing through those points. No difficulty ever occurred in the maintenauce of the rules necessary for working those points. The scantling of the longitudinal balk used for the earlier construction of the Great Western Railway was smaller, and the system different from that adopted since. The balks upon the present system have not been altered. Formerly, upon the greater portion of the line, the timbers were about 13 by 6, laid flat, but they were simply timbers as imported, cut into two or three to the thickness required, and they were not parallel or straight, and the rail could not be placed exactly in the centre of the timber, and the timbers were of unequal breadths. Afterwards succeeded in getting timber imported parallel, and of equal scantling. The width and depth of balk on the Great Western line varies a little, according to the circumstances of the case, from 13 by 6½ to 14 by 7. His system is not to give any transverse support under the longitudinal bearings, but to allow them to rest upon the ballast. The introduction of cross sleepers under the longitudinals appeared to produce a bad effect. Impossible to make the bearing of the cross sleeper coincide in extent and degree exactly with the bearing of the longitudinal, hence the whole systam did not rest equably upon the ballast. Witness's system for keeping together the two longitudinals, and preventing an extension of the gauge, is to keep two longitudiuals apart by a strut of wood; they are bolted together by two iron bolts and strap, the strap being bolted to transoms; by this method, if any accident occurs by which the transom is broken, the gauge is not disturbed. Has tried the transverse supports under the longitudinal bearings at intervals varying from 3 to 10 feet apart. Is desirous carefully to distinguish an expression of opinion, as regards transoms, from any opinion as to transoms used independently of longitudinals. Nothing can be better than the bearing of transoms when used independently of longitudinals, but the two cannot be combined advantageously. The mere circumstance of the transom being deeper in the ballast than the longitudinal, makes at once a difference in the extent to which it bears upon the ballast, and it would be affected by a shower of rain or anything else that affects the ballast. Should adhere to the 7 feet gauge in constructing railways in new countries, provided the circumstances were the same as those which led to its adoption on the Great Western Railway. In Ireland, where the gauge is almost an open question, looking at the traffic of that country, should be disposed to take the broad gauge of the Great Western Railway in preference to any other gauge. Was engineer of the Taff Vale; decided the gauge for that line. The principal circumstances which induced him to depart from his more general system in that particular instance would not influence him at present. At that time assumed that the effect of curves was such that the radius of the curve might be measured in units of the gauge. Has siuce found himself mistaken in this particular. Expected also to have to lay out that line with a succession of curves of small radius, and assumed that the narrow gauge was better than the wide gauge as regarded curves. There were previously some mineral lines in that neighbourhood, but they were tram-roads. Is the engineer of some projected lines in Ireland. Has understood that the question as to the gauge of these lines has been decided by higher authorities, and that it is to be 5 feet 3 inches. Does not see much advantage in the 4 or 5 additional inches. If the gauge is still to be determined for Ireland, thinks it would be better to take a wider one. The present traffic of that country in passengers and goods does not require the additioual power obtained on broad-gauge liues. Is the engineer of the railway making from Genoa to Turin under the Sardinian Government. The entire length of all the lines projected is about 300 miles. The question of gauge is an open question; has decided for that particular line; recommended a gauge of 4 feet 8½ inches. In England the broad gauge is preferable to any other, but in the Sardinian Railway on which great speed may not be desirable, all the circumstances are so different as to induce him to prefer the 4 feet 8½ gauge. In the proposed railway to Port Dynllaeu from Oxford he contemplates using the broad gauge. The traffic of that district would probably equal the traffic of the Italian line. Looking at the whole question, is of opinion that he has, in the main, realized the object he had in view in the adoption of the wider gauge. Formerly attached more importance to curves than he does at present. Has since found by experience that the curves do not seem to affect the motion upon the broad guage more than they appeared to affect the motion of carriages upon the narrow gauge. Has investigated the cause, and found that, as long as the gauge bears but a small proportion to the radius, the width of the gauge does not affect the aetion of wheels upon the curve. The bad effect of a eurve is aggravated only by the longitudinal distance of the axles from each other. Has daily experience of the facility and safety of running round curves quite as small as any on the narrow gauge. The curve at Bristol is the most severe one run over at a high speed. This curve close to the station, but one upon which in-coming trains from Exeter do every day run at high speeds; it is about 11 chains' radius. Does not think, that as the outer wheel travels further than the inner, there is more sliding of the wheel upon the broad gauge than upon the narrow. Attaches no value to the effect of the cone, as to running upon a larger circumference or a smaller circumference, in going round the curves. Possibly the average amount of slip, if there is any, may be a little greater in going round the curve of the wide than of the narrow gauge, but is certaiu tha the amount of provision furnished by the coning of the wheel is far greater then either of them requires. The cone of the wheel is run flat upon the top of the rail, the rail slightly inclined. The wheels are not originally made so as to form a straight line; the section is rather curved; no part of it is a straight line, and as the rails are slightly curved the other way it is impossible that they can lie flat; the contact is not an eighth of an inch wide. In the driving-wheel of the engine a flat bearing upou the rail is more carefully attempted than with the carriages, because where a great weight is thrown it is essential, as far as possihle, to get a large surface the extent of contact is very small iudeed, even in au engine it is not a quarter of an inch wide. Has not discovered any inconvenience from the width of the gauge with reference to curves. If he had now to construct the Taff Vale Railway with the same curves, should not abstain from forming it of the broad guage on accouut of the curves; they are making smaller curves every day upon the broad gauge. In the event of the general adoption of the atmospheric principle, is of opinion that it should be constructed on the broad gauge rather than the narrow. The reasons which iuduce him to prefer the broad gauge on the present system would apply perhaps not with equal force, but in some degree to the atmospheric ra way. Every circumstance connected with the construction of the railway is in favour of the wide guage as regards the safety of the carriages and the facility of their running at high speeds; but should not be at all afraid of running carriages at 60 miles an hour on the narrow gauge. It is impossible to say from what cause many accidents have arisen. A slight depression of the rail caused a serious accident to the train in which he was travelling. Cannot say whether the same amount of depression would or would not have caused an equally serious accident upon the hroad gauge. Of the two, the broad gauge must be the safer under the same circumstances. If high speeds are to be very general, and if most of the trains are to be running at high speeds, and the speeds are to be still further increased, the wider the gauge the safer it will be. In witness's opinion, the comparative merits of the two systems of railways are not altered by the great increase of power which is given now to the engines upon the narrow-gauge railways. Never assumed that the engines originally in use on the London and Birmingham Railway could not be greatly increased in strength upon the narrow gauge. Is not aware that there has been lately any particularly great increase in the means of putting a large power upon the narrow gauge. In speaking of powerful engines, he is speaking of engines of great capacity of steam; not of engines with 15 inch or 24 inch cylinders, both of which may have the same boiler, hut of engines of great capacity of steam, capable of exerting a large quantity of power in a short time. There has been a great increase on some narrow gauge railways in the dimensions of their cylinders, and they have all gradually increased the size of their boilers, yet does not know of any new system of engine introduced latterly which has admitted or which has led to engines of greatly increased power as a class. Impediments to the traffic of the country caused by break of gauge will occasion some inconvenience. Its amount will depend much upon the particular line of country in which the change takes place, and upon the interest of the parties on either side to increase or diminish the amount of that inconvenience. If the change took place across the country, so as to separate London from the North, that would he a case of the greatest interruption, and would, of course, produce a good deal of inconvenience. If that change took place as between one portion of England and the other, leaving London open to both, the inconvenience would be small. If it is the interest of the parties on both sides of the neutral country to effect a transit through it, believes that it will be very small indeed. The inconvenience will be diminished even with the extension of the railway system. It will be impossihle that passenger carriages can travel in all directions over the country without changing if railways are largely extended. Change of carriages under such circumstances is advantageous to the public. Competition between different great railway interests, as regards the comfort and the times and mode of travelling, will do more good to the public than that uniformity of system which has been so much talked of for the last two or three years. As the number of railways extends over the country, it will become more and more impossible to send individual passengers by separate carriages to the exact place of their destination. A change of carriages must, n a great many cases, take place, and if that change takes place over a general line of country, it will gradually influence the mode of travelling throughout all the directions in which lines may be carried, and will then amount to a very trifling inconvenience. The inconvenience of a break of gauge in respect of goods traffic, is merely a question of money. With a large goods traffic the inconvenience will be small. Is of opinion that it would be desirable that the passengers going from London northwards should be able to go without changing at Rugby, where there can be no great reason for their changing if they are going northwards upon the same line. Does not think the same amount of inconvenience would he felt by the public in the change of gauge at Rugby by persons coming from the north going to Oxford; the persons going to Oxford would consist of persons coming from several different lines to Rugby. As the number of railways extends, it will he quite impossible to send carriages from each line on to the uniting line to he severed again, perhaps into two or three a little further off; the amount of stock required for such a thing would be too enormous as the railway system extends. The amount of stock for passengers travelling from the north to Oxford will not be increased by having a double set of double carriages, the narrow and broad, to meet at Rugby, provided the extent of the line be sufficient to get the fair work out of that stock. The amount of work got from the stock is diminished by attempting to extend it too far into other districts. If the broad gauge system of railways south of Rugby has a sufficiently extensive line under work to employ their carriages, it will not beneficially employ them to send them sometimes from Rugby on towards one direction to spread off into other branches, sometimes into other directions, where they may not have immediately a return traffic to the south. The extent of broad gauge railways is quite enough to employ to the utmost their stock. It cannot, therefore, diminish the proportion of stock required to extend them to others, and he helieves it would increase them. If a train is running from Oxford to Rugby to meet the trains running to the north, if that is part of a system which beneficially employs their stock, there is no advantage in sending the carriages beyond that point. There is a limit which many companies are fast passing of the beneficial employment of stock hy attempting to branch into too many. The system of the clearing-house does not meet the difficulty of the carriages of one company running over the line of another. It cannot meet the difficulty of a carriage arriving at a small station, and having nothing to bring back. The clearing-house system, which has grown into such extraordinary reputation by the discussions of last session, is simply a business-like way of ascertaining where the carriages are; there is nothing very extraordinary in the arrangements; it is a very business-like mode of ascertaining the amount of stock that has run upon different lines. The clearing-house system is not an economical arrangement, and never can be made suoh. If the line be made by the Great Western Company from Rugby to Oxford, would prefer using the broad gauge between those two points. Admits that great public convenience would result from bringing the whole of the railways of the kingdom into one uniform gauge. On the other hand the public would lose the benefits now derived from competition The express trains, if they are an advantage, arose entirely from the competition between the two gauges. Has no fear that the rivalry between the various Companies may induee them to aim at a degree of speed which would do mischief. Public confidence is more necessary, for their receipts, than even the public desire to go quickly. Has not the slightest doubt that there is a loss of revenue arising from every accident or every reported accident. This cannot be ascertained by examination of the accounts. After the accident on Great Western Railway with the express train there was a diminution in the receipts of that train. In the event of a break of gauge taking place at Rugby, passengers would be treated in the same way as at Didcot, which would then become a less important station, and would probably no longer be an exchange place. The trains and carriages would run directly from London, through Didcot, to Oxford and Rugby. The change would take place at Rugby, just as it does now at Didcot. The precise distance from Rugby to London by the Great Western would be 114 miles. Has made no arrangements as to the manner in which goods would be sent on this line; it must depend upon what the other companies choose to do; if they do not afford assistance,—will not say if they throw impediments in the way—but if they do not afford assistance to exchange, the mode must be different from that which it would be if they did. As regards coal there would be every facility; as from the large quantities carried, the coal owners are themselves interested in devising the best means of transport. As regards general goods, the arrangements must depend upon what the other companies may choose to do; the worst that could happen would be the entire unloading and reloading of the goods; even that does not amount to anything in time or money that would be much felt by the public. It would not necessarily involve a detention of even two or three hours, nor would it probahly he an increase of two or three hours upon the time occupied between a northern and a southern town. Goods are picked up at various places between Exeter and Bristol, and are delivered at the various places hetween Bristol and London, and it is not inconvenient to restow many of those goods on their passage. The system of loading and unloading would depend entirely upon the extent and nature of that trade. If there were large quantities of goods in bulk, transhipping the body of the waggon would be most convenient. If waggons were with various goods, and no assistance whatever was afforded by other companies, and they were not unpacked, taking waggon and all upon another truck, would be adopted. Sees no practical difficulty in such an arrangement; the useless weight carried would be the only drawback. The introduction of another pair of rails, or another rail to diminish the gauge on that line, would he more objectionable. The object to be attained is not sufficiently great to make this the most economical way of doing it. The additional rail will supersede the necessity of introducing the loose boxes.. The introduction of the loose-box system would not involve the necessity of altering every coal waggon now on the line. There is no difficulty whatever in keeping a set of waggons for that particular branch of trade. The trade is regular, the demand and supply are very regular, and there is no difficulty whatever in having, particularly for the large consumption of Oxford and the neighbourhood, a stock devoted to that particular purpose. That stock would be a new one, and if the line is made to Rugby, the coal-owners and all parties carrying coal will forget all their difficulties, and be too happy to have a stock made to supply the Oxford market. The Oxford Market is now supplied with coal by canal. Anticipates that the coal brought on Rugby line would be principally deposited at Banbury, Oxford, and down on the Great Western, 15 or 20 miles. The evaporating power of the present largest Great Western engine is 196 feet per hour. His preference of the broad over the narrow gauge arose from an opinion that, for quantity and velocity, that dimension of machinery is more advantageous, and that the advantage of it will increase with the quantity of goods to be carried, and the speed at which they are to be carried. If, as he believes, there are advantages as regards safety and comfort, and general facilities for constructing a convenient carriage upon the wide gauge superior to those facilities on the narrow, of course, that remains the same whatever may be the quantity of goods carried. If the railway system is extended, so as to include a greater number of small towns than at present, the advantages of the broad gauge would be diminished, but the narrow gauge has no advantage over the broad gauge; does not know what advantage the narrow gauge has under any circumstances over the broad. An engine of a given power on the broad gauge is not practically more expensive than on the narrow; the difference is too trifling to be worth mentioning. The cost of a carriage on the wide gauge is not more expensive than on the narrow; all the guards, enginemen, conductors, and everything of that kind, would remain the same; all the station expenses would be the same. The difference of a carriage able to hold 12 people, and one able to hold 9, would not affect the working of the line, particularly branch lines. If it were intended to construct and work a line of five miles long with a very small traffic upon it, it might then be a question whether a 4-feet guage, even with very small carriages, and with something very cheap and small in the way of an engine, would not be worth attempting; but when a branch forms part of larger lines, and is worked in with those larger lines, those advantages diminish so much that they almost cease to operate. The broad gauge trucks carry 9 tons, the narrow gauge 5 tons. In heavy goods the difference between the two gauges is not so material, and it may have no effect at all. In the case of all light goods, and all goods for which any space is desirable, it is easier to get a roomy waggon on the wide gauge than upon the narrow. It is probable that many of the broad gauge trucks which pick up loads at the small stations ou the Bristol and Gloucester Railway are not above half filled. In such a case there is an actual loss from the conveyance of a heavier carriage upon the broad gauge. The amount of loss is very small, because the broad gauge waggons are not heavier than the narrow in the exact proportion to their width, all other things remaining the same. The wheels are the same, the buffers are the same, the springs are the same, the side-plates are the same. There is more dead weight in proportion in the broad than in the narrow, in reference to the construction of the waggon. The gauge does not, of necessity, involve a much greater dead weight. If a narrow gauge waggon is cut in two in the middle, and widened by putting in a piece between, that waggon will be perfectly fit to run upon the broad gauge. A broad gauge waggon is proportionably higher, not heavier in proportion. A comparison of the weight of broad and narrow gauge waggons affords no fair criterion. The difference of weight between the two not necessarily caused by the increased gauge. Could make a broad gauge waggon actually lighter than a narrrow gauge waggon. If he were projecting a line from London northwards, running through the districts which are now fed by other railways, depending upon the traffic brought from those other railways, he should not think it necessary to propose a different gauge. Considers Rugby a great railway metropolis or focus, and although the Rugby and Oxford line will pay, yet does not think it is a line with such an amount of traffic upon it as to be running trains from Sheffield to Southampton, or from Birmingham to Southampton, and other places. Does not see at present any great public necessity for connecting lines between the Great Western and London and Birmingham, except between Rugby and Oxford. The diameter of driving-wheels on the Great Western is 7 feet, and some 8 feet, for passenger engines. Two or three engines were made with 10 feet driving-wheels, but soon disused, as they totally failed: but not from any defect in the wheels, nor from their size. Considers his original views in reference to the diameter of driving-whcels confirmed by experience. If it were necessary to lay down narrow and broad gauge rails upon the same line, could combine them, if thought desirable, without any difficulty. There are two ways in which this may be done; either to put two complete additional rails, which is the best plan of the two, or to put only one additional rail. With one additional rail, and the ordinary mode of laying rails upon cross sleepers, there is no difficulty whatever. The difficulty is a little increased by the longitudinal system, but the two timbers, at 2 feet apart from centre to centre, bolted together, do not offer any material difficulty of construction, and there is no difficulty in constructing a line with a 5 feet and a 7 feet gauge. Could insert such a line in an existing line upon the wide gauge. The expense, per mile, of making this change would practically amount to hardly anything more than the timber and the rail, and the labour of placing it; there is no difficulty in the placing. Two additional rails could only be placed in a wide gauge railway, by bolting on to each longitudiual an inner longitudinal in contact with it. In fact, by widening the present longitudinal. The only difficulty would be that each rail would not be in the centre of the longitudinal. In this case the surface altogether would be so large for each, that there would be no inconvenience. Would propose to bolt the longitudinals so firmly together that both would be raised in packing. At present there are many approaches to the stations, where there are long easy curves running into a straight line, and a considerable length of them consists of double timbers as the rails approach each other. If a double line of metal were laid within the broad gauge in that manner, carriages of different gauges might run intermixed in the same train. Does not think that it would be done, but sees no difficulty in such an arrangement. If only a single metal were put in, should conceive it practicable to run carriages upon the different gauges in the same train, the traction being eccentric in one or both. Should not attach so much importance to that as to the necessity of new arrangements for the boilers. There would be some objection to the traction being out of the centre, but that is not material. In this case which witness first supposed of two metals interposed, the carriages would buff perfectly, as the width and height of the buffers happen to correspond. Per centage on receipts does not give at all a true idea of the actual cost of locomotive power. In the first place, the locomotive account may be debited with various items differing in different establishments, and the proportion of it to the gross receipts really may be greater in the cheapest establishment than it is in the dearest. The proportion depends upon the rates of tolls and fares, as affecting the gross receipts, upon the nature of the traffic, and upon so many other considerations, that it is almost the worst ratio that can be taken. Cannot suggest any means to arrive at a clear understanding of the relative cost of working the two systems, without going into all the detai of the accounts. Even then no correct result can be shown in figures. The working of a long branch, upon which the trains may be very light, will render the total average greater; the running of trains at particular hours to suit a particuluar class of traffic will, of course, affect the proportionate expenses. The London and Birmingham Railway, upon which the great bulk of the traffic goes from end to end, ought to give a low return, in point of cost of locomotive power, and in regard to all expenses. Upon the Great Western, with which witness is better acquainted, the large traffic to Slough, the large traffic to Reading, the small traffic in the middle of the line, and then the large traffic at the other end again between Bristol and Bath, and that neighbourhood, ought to increase considerably the proportionate cost of everything, whether locomotives or guards, or wear and tear of carriages, or anything else. All that must be taken into consideration; having first tried to obtain a correct return of the expenses of two lines, by taking care that exactly the same items are carried out in the account. Consideration of the arrangement suggested by which, in the event of the break of gauge taking place at Rugby, goods coming from the narrow gauge lines to join the broad gauge line at Rugby, could be taken forward upon low trucks, to relieve the difficulty of a change of carriages. The traffic upon the Great Western line, as at present worked, is very unequal, the largest portion of it lying between London and Reading, and Bath and Bristol. On this account it is difficult to work the whole line as economically as it could be worked if the traffic were equal throughout because many trains that run through from London to Bristol, when they pass the centre part of the line are comparatively empty. The whole line cannot be worked as economically as the portion between London and Reading, or as another line which has an equal traffic throughout. The good gradients upon the line between London and Bristol ought to have a considerable effect in diminishing the cost of locomotive power between those places. But it is to be observed that there are two inclined planes of 1 in 100 upon that line, and also that these expenses include the Bristol and Exeter line, which has not gradients to be compared with those of the Great Western. He regrets that his engagements have rendered it impossible for him to give that attention to the subject which it deserves and calls for, but suggests to the Commissioners from the course the evidence has taken, that it is imperative that some experiments should be made to test the accuracy of the many opinions which have been given. As regards the mechanical results of the wide gauge, if experiments are made, it will be found that up to the present time speed, economy, and safety, are attained to much greater extent on the wide gauge than on the narrow. That if such experiments are made under their own observation, they will be able to satisfy themselves, also, that while on the narrow gauge they have by great exertions arrived at the state which they have at present reached on the wide gauge, the latter have the means of making further advances in all those points, to almost as great an extent as the advances which the narrow gauge has made within the last few years. With respect to those experiments, would suggest that they should not be limited to one or two, but that they should be sufficiently numerous to obtain a fair average result, and that, in testing speed and power, considerable distances should be run over upon lines with varying gradients, as well as upon lines selected for their flat gradients. On the broad gauge there are plenty of lines which offer very steep gradients, as well as considerable distances which will afford flat gradients; and to test the real capabilities of different engines it will be desirable to test them upon varying gradients. Suggests that the mode of trial most likely to give the desired information, would be running a train of 50, 60, or 70 tons at a high speed between London and Exeter, as embracing gradients of every variety, and probably also between London and Swindon, as having only easy gradients. These experiments should be repeated several times with different loads; and probably increasing the load to about the limit of the power of the engine at the speed of 50 miles an hour. The line from Swindon to Gloucester would be a severer test than from Bristol to Exeter. There is a gradient upon the former line of 1 in 60, or 1 in 66. The line from Taunton to Exeter is also a line with steep gradients, clean and in good order. Does not think the matter can be tested by experiments for short lengths; a slight circumstance affects the velocity; the fire being bright or dull affects the result with a short distance. The narrow gauge line sufficiently long for the test is the line from London to Liverpool. With respect to the power of the engine, by taking the time at every quarter of a mile over the different gradients, a tolerably correct comparison could be made with lines merely differing in the arrangement of their gradients. The Great Western Company are building an engine with very considerably more evaporating space than the largest present engines on the broad gauge. With their arrangements they are capable of having engines of very much greater capabilities than their present engines; they can double their largest engine now upon the line without making any inconveniently large or heavy machinery, whereas the engines which will probably be used in the experiments upon the narrow gauge may show the result of straining very much the dimensions of the machine. Imagines that the advocates of the narrow gauge would wish to try some experiments upon their most level lines; there is the Northern and Eastern, and the Dover is also a tolerably level line. At present the evidence stands very much upon opinion; therefore experiment would test the correctness of those opinions. With respect to the statements as to the wear and tear and the cost of locomotive power, would ask the Commission to have the goodness to examine the accounts in detail, because witness's conviction is that, when so examined, it will turn out to be true, as supposed and assumed, that, in their locomotive cost and the general cost of wear and tear of machinery and plant, including carriages and carriage-wheels, wagon-wheels, and axles, there is a considerable economy in the wide gauge system; the number of fractured wheels and axles can be ascertained positively from the different companies: those are elements in safety; although carriages may not actually overturn for want of width and weight, yet a very large proportion of accidents do arise from fracture or derangement of the whole machine, which are materially affected by the dimensions of that machine. Proposes that a series of experiments should be made with loads, exclusive of the engine and tender of 50, 60, 70, and 80 tons, carried at regulated speeds of 40 and 50 miles an hour, and also at the speeds which the engines are capable of, if higher, and that the expense of working these engines should be tested as accurately as possible during the experiments, and that those experiments should be made on the Great Western Railway between London and Swindon between London and Bristol, and between London and Exeter, as giving a great variety of gradients, the circumstances of which can be ascertained exactly, and that those experiments should be compared with experiments upon such other lines as the advocates of the narrow gauge thought were fair subjects of comparison. Submits that, for any fair result, it would be most desirable that the experiments should be carried on at the same time, not perhaps on the same day, though that would be almost desirable; they might be going on at the same period, because the state of the weather affects the results very much; and also, in order to make a fair series of experiments which are to terminate at some period or other, it would be desirable to fix beforehand the experiments which are to be made, and then to follow them out. The expense of repairs on the Great Western is put down so large as to keep up the stock of engines perpetually in repair.

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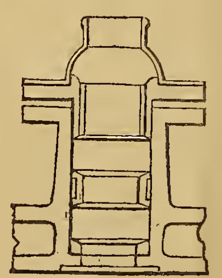
## ART. II.—DETAILS OF OSCILLATING ENGINES.

It is very expedient that the stuffing-boxes of all marine engines should be deep, as they will not otherwise admit of much screwing up, and will be apt to become leaky at sea. The stuffing-boxes of oscillating engines, however, must be much deeper than those of common engines, so as to obviate the tendency of the cylinder and stuffing-box wearing oval. Fig. 1 represents a cylinder stuffing-box of the steam vessel *Trident,* constructed by Messrs. Boulton and Watt, drawn to a scale of half an inch to the foot. There is a central brass in this stuffing-box, and above and below this central brass hemp packing is interposed. The more usual practice, however, is to construct the stuffing-box of oscillating engines with a very deep brass bush, and above this bush to introduce the hemp packing. In the engines of the *Ariel* just completed by Messrs. Penn, with cylinders 68 inches in diameter, and 4 feet 6 inches stroke, the total depth of the stuffing-box is 2 feet 6 inches, and the part appropriated to the reception of the packing is 6 inches deep. The brass dome attached to the gland of the stuffing-box of the *Trident* is intended to prevent the grease from being spilt by the oscillation of the cylinder, and also to wipe from the rod any grit or dust which may adhere to it, and which would otherwise be carried into the packing and might scratch the rod into grooves. Metallic packing in the stuffing-box has been used in common engines, consisting in most instances of one or more rings, cut, sprung out, and slipped upon the piston-rod, before the cross-head is put on, and packed with hemp behind. This species of packing answers very well when the parallel motion is true, and the piston-rod free from scratches, and it accomplishes a material saving of tallow. In some cases a piece of sheet-brass, packed behind with hemp, has been introduced with good effect, a flange being turned over on the under edge of the brass, to prevent it from slipping up or down with the motion of the rod. To prevent any disturbance of the valve motion from the oscillation of the cylinder, it is usual to communicate the motion of the eccentric to the valve by means of a curved link guided vertically, and so continued that the link allows the cylinder to vibrate without affecting the perpendicular movements of the valve rod.

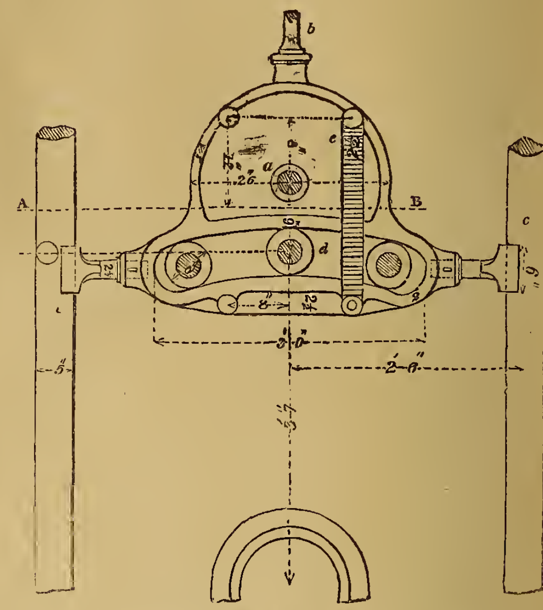
Fig. 1.



STUFFING-BOX OF OSCILLATING ENGINE.
Scale half an inch = 1 Foot.

Fig. 2, represents the valve attachment of H. M. steam vessel the *Trident,* already referred to, cylinder $70\frac{3}{4}$ inch diameter, and 5 feet stroke, and reckoned at 350 horse power. The eccentric rod is attached to the stud *a,* which is fixed to the centre of a cast iron block forming part of a frame which is guided vertically by means of the guide-rod *b,* and by the columns

Fig. 2.

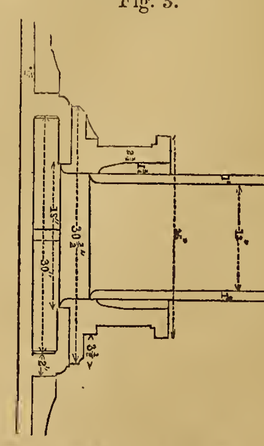


VALVE GEAR OF OSCILLATING ENGINE, BY MESSRS. BOULTON AND WATT.
Scale half an inch = 1 Foot.

of the engine at *c c,* and which also serves as the back balance of the valves: *d* is the end of the valve lever which is moved up and down by the frame, whatever position in the arc the end of the lever may occupy in consequence of the oscillation of the cylinder: *e* is a rack whereby the frame may be moved up or down by means of a shaft at AB, when the eccentric rod is not in gear, and at the end of the shaft a wheel is situated for starting the engine. The curved groove in which the end of the valve lever moves is a part of a circle, but is not swept from the centre of the trunnion when the valve is at half stroke, but with a radius equal to the distance of the centre of the valve-shaft from the centre of the trunnion, when the cylinder is perpendicular. Messrs. Penn do not form the curve in this way, but sweep it from the centre of the trunnion when the valve is at half stroke; and although the same motion of the valve is not thus obtained as when there is no oscillation, the difference is very slight, and is moreover considered to be a better motion than if no disturbance had taken place. It appears to us that the use of a curve might be dispensed with altogether by observing a suitable adjustment of the eccentric; the effect would be to increase slightly the side pressure on the piston rod, but the increase would be altogether inappreciable in the case of equilibrated valves, which may be wrought with an inconsiderable exercise of force.

Fig. 3, represents one of the trunnions of the *Trident,* which instead of

Fig. 3.



TRUNNION OF OSCILLATING ENGINE, BY MESSRS. BOULTON AN[D W]ATT
Scale half an inch = 1 Foot.

being cast upon the cylinder, as is the usual practice, are each bolted on with twelve $1\frac{1}{4}$ inch bolts, and are strengthend by twelve brackets, I inch thick, cast on the flanges of attachment. There is a projecting ring, it will be observed, left upon the part whic h is to be bolted on, whichis accurately fitted into the hole in the belt in order to obviate slackness sideways. A rib $1\frac{1}{2}$ inch thick runs back from the hole on each side in the middle of the belt, to tie the belt more effectually to the cylinder, and above and below the belt a feather runs vertically $1\frac{1}{2}$ inch thick, and tapering in depth from the belt till it runs off to nothing on the cylinder side.

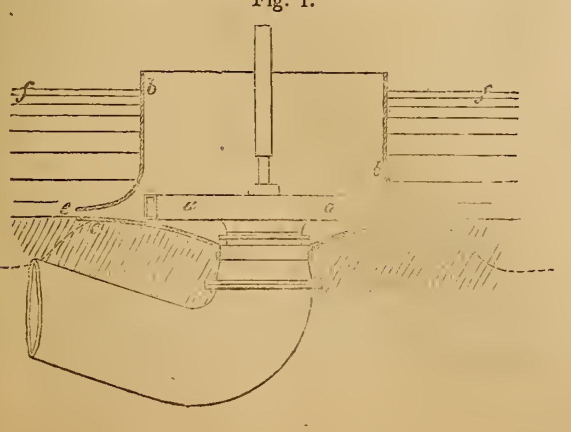
The bearing part of the trunnion is 22 inches in diameter, 7 inches long, and the metal is $2\frac{1}{4}$ inches thick; the steam pipe entering the trunnion 1 inch thick, and the packing space between the pipe and trunnion $1\frac{1}{4}$ inch wide. The gland for compressing the packing is usually put on in two pieces. The pipe requires to be so made that it can be pushed in against the cylinder in order to accommodate its outer attachment. It is not necessary to make provision at the outer end of the trunnion-pipe for the falling of the trunnion by wear, as the wear is so small as to be of no practical moment. The thickness of metal of the cylinder is $1\frac{1}{2}$ inch; the thickness of the top and bottom of the belt is $2\frac{1}{2}$ inches in the wake of the trunnion, and 2 inches in other places. The diameter of the hole in the belt is 18 inches; the internal diameter of the steam pipe is 13 inches; and the diameter over the flange for the attachment of the trunnion is $30\frac{1}{2}$ inches. The interior of the belt in the wake of the trunnion measures 29 inches deep and $4\frac{1}{2}$ inches wide. The crank shaft bearings are 12 inches diameter and 13 inches long. The paddle wheels are overhung, and the outer journal of the shaft is 14 inches in diameter, and 14 inches long; the part on which the centre is fixed, from whence the arms diverge, being 16 inches diameter, and 24 inches long. When the paddle is overhung, the shaft increases in size at the outer end, instead of diminishing as in other cases. The diameter of the wheels is 22 feet; the floats are 2 feet broad aad 9 feet long, and have a dip of 4 feet 7 inches from the load water line, at which point the vessel draws 11 feet of water. The crank pin is 9 inches in diameter, and has a length of bearing for the connecting rod of 14 inches. The diameter of the Trident's piston-rod is $7\frac{1}{2}$ inches; we think the introduction of larger piston-rods than have yet been introduced in oscillating engines would be an improvement, and would add to the durability of the engines. Each cylinder measures 8 ft. 1 in. across from centre to centre of trunnion, and 11 ft. 6 in. from the level of the trunnion to the level of the shaft.

The position of the trunnion should be a little above the centre of gravity of the cylinder, so that it will have no tendency to tilt over when the piston-rod is disengaged from the crank-pin, and very little tendency at the same time when pushed over to resume the perpendicular. The plan of attaching a weight to one side of the cylinder to balance the valve casing is now discontinued in the best engines, and two valves are employed which balance one another. These valves are placed one on each side of the trunnion, so that they may both be wrought by the same eccentric. If the curved eccentric frame were discarded, the eccentric rod might be attached immediately to a cross-head, from the ends of which the two valve rods descended, and the intermediate gear at present used might thus be dispensed with.

## Art. III.—MR. WHITELAW'S EXPERIMENTS ON BARKER'S MILL.

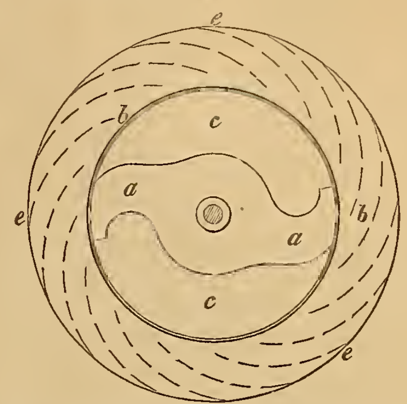
The whole power of the water being 100, the water-mill with which the fourth series of experiments was made, will, as we have already seen, give a result above 75; and at the same time a power of upwards of 15 will remain in the water after it has left the discharging orifices of that machine. As the power which escapes with the issuing water, might be made use of for keeping the tail-water off the water-mill in time of floods, the following remarks are made in the hope that they may lead to some good plan of effecting this end, as there are many water falls the value of which would be greatly increased were it possible to keep the water-mill clear of tail-water during floods, and at the same time not have it set so high as to prevent the whole pressure of the water being taken advantage of at times when the water would be low in the tail-race.

Fig. 1.



A contrivance similar to that represented by figs. 1 and 2, might be found to answer the end of keeping the tail-water off the water-mill in time of floods. The water-mill *a a* works inside of a circular casing *b b*, and the round plate *c c* is placed at some distance under that casing. The plate *c c* is fastened to the end of the main-pipe, and the casing *b b* may be supported or fastened by means of stays, either to the building of the mill-pit, or to the plate *c c*. As the water will have to pass out through the opening *e e e*, its momentum should prevent the external water from entering the casing. If thin plates, as represented by the dotted lines in Fig. 2, were put

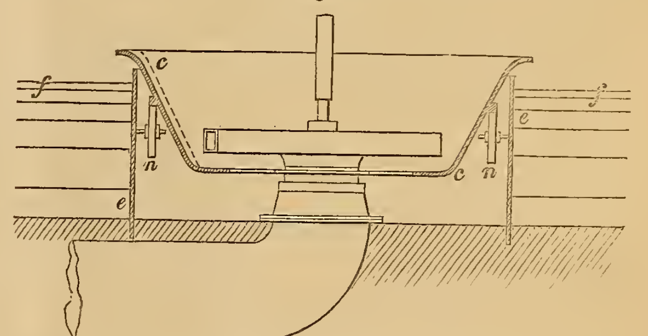
Fig. 2.




into the aperture *e e e*, they might assist in keeping the tail-water out of the casing. In situations where the tail-water, in time of floods, does not rise a great way above the bottom of the water-mill, the casing *b b* may be dispensed with. If the plate *c c* be used without the casing, the bottom of the tail-race should be as low as the dotted lines shewn in Fig. 1. In Fig. 1 the water-mill is represented rather too low; its bottom side should be a little way above the highest part of the plate *c c*. The surface of the water is marked *f f* in Fig 1, and in that which next will be described.

A circular casing *c c*, Fig 3, supported by and revolving on rollers *n n*,

Fig. 3.



might be found to answer the purpose of keeping the tail-water of the water-mill. The hollow cylinder *e e* is sunk into the bottom of the mill-pit, in order to prevent the tail-water from coming in coutact with the revolving casing. The dotted line represents one of a number of blades which may be fastened to the revolving casing for the water to act against. The centrifugal force occasioned by the rotary motion of the casing *c c* will cause the water which leaves the discharging orifices to be thrown over the top of that casing into the tail-race. Any water which may happen to get inside of the cylinder *e e*, will pass through the large aperture in the bottom of the revolving casing, and be carried into the tail-race.

If the revolving part of Fourneyron's turbine were placed outside of the water-mill, the tail-water might be prevented from coming in contact with the arms, provided the bottom of the outer revolving part were so formed that the exterual water could not get in by it.

Or it the water-mill and the revolving part of the turbine were both kept above the surface of the tail-water, some power might be obtained from the outer revolving part. If the water-mill and the revolving part of the turbine were kept entirely out of the tail-water, it would be advisable to have the outer revolving part made of a large diameter, and not have too many passages for the water in it. Perhaps two apertures or passages for the water, as shewn in fig. 4, would be sufficient. The duty of Fourneyron's turbine, when that machine is worked out of the tail-water, would be increased, if the escaping water did not retard the revolving part by keeping in contact with its outer edge all the way round. The plan of revolving part, represented by Fig. 4, would not labour under the disadvantage now pointed out, if its diameter were as large as say 40 times the width of the jets. The two water-spaces are marked *a a* in that figure.

Fig. 4.


We do not think it isnecessary to work Barker's-mill at so low a speed as to allow 15·14429 per cent., of the whole power, to remain in the water after it has left the machine; neither is it our opinion that 75.28 per cent. of the whole power of the water is all that can be realised from that kind of motor, though the results of the fourth series of experiments, so far as we have yet examined them, seem to lead to these conclusions. Yet, as 75.28 per cent. is a good result, it might be as well not to aim at a higher, when constructing machines for situations where they would be frequently flooded, provided some good plan could be devised for making that portion of the power which would pass away with the escaping water, available for the purpose of keeping the tail-water off the water-mill. We may here remark, that a water-mill made for the express purpose of being worked in the tail-water, should turn or revolve at a slower speed than one made for working clear of the tail-water.

As the results of the fourth series of experiments have now been examined in one way, it may be as well to collect the formulæ that have been obtained into the following table, partly because we may have occasion to refer to them hereafter, and also for the reason that this will give an opportunity of correcting a few typographical errors contained in them.

TABLE 1.

$P = \cdot000000346316r^4 - \cdot000304827r^3 + \cdot0971297r^2 - 13\cdot2491r + 723\cdot5$ . . . A

$w = 1481\cdot645\left(8 + \overline{\cdot01269007r}^2\right)^{\frac{1}{2}}$ . . . . . . . . . . . . . B

$V = ch^{\frac{1}{2}}$ = *the velocity of the water in feet, per second, when the machine is not in motion* . . . . . . . . . . . . . . . . . . . C

$V = c\left\{h + \left(\frac{v}{8\cdot0458}\right)^2\right\}^{\frac{1}{2}}$ = *the velocity of the water, in feet, per second, when the machine is in motion* . . . . . . . . . . . . . . D

The following equation may be used in place of that marked *D*, if the diameter of the water-mill be = 1·3 feet.

$V = c\left(h + \overline{.01269007r}^2\right)^{\frac{1}{2}}$ . . . . . . . . . . . . . . . . E

The height of the fall being 8 feet, and the diameter of the water-mill 1.3 feet, we get

$V = c\left(8 + \overline{\cdot01269007r}^2\right)^{\frac{1}{2}}$ . . . . . . . . . . . . . . . . F

$w = 39880\ ca\ \left(8 + \overline{\cdot01269007r}^2\right)^{\frac{1}{2}}$ . . . . . . . . . . G*

$\frac{Q\,h}{696\cdot732} = n$ . . . . . . . . . . . . . . . . . . . . . H

$\frac{\cdot135\,n}{h\,h^{\frac{1}{2}}} = W^2$ . . . . . . . . . . . . . . . . . . . . I

$\left(\frac{\cdot135n}{h\,h^{\frac{1}{2}}}\right)^{\frac{1}{2}} = W$ . . . . . . . . . . . . . . . . . . . K

$4\,W = d$ . . . . . . . . . . . . . . . . . . . . . . . L

* Note.—$c = 7.853984$. And if formula G be applied to the results of the fourth series of experiments, we must take $a = \cdot004730412$ and $ca = \cdot03715258$.

$50\,W = D$ . . . . . . . . . . . . . . . . . . . . . . M

$10\,W = C$ . . . . . . . . . . . . . . . . . . . . . . N

$\frac{149\cdot4338h^{\frac{1}{2}}}{D} = R$ . . . . . . . . . . . . . . . . . . O

The formulæ contained in the above table were fairly deduced from experiment, and therefore the results they give may be relied on.

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In what follows we shall endeavour to exhibit Barker's mill in another and far more important view than that which has hitherto been taken of it.

$h + \left(\frac{v}{8.0458}\right)^2 = h + H$ = *the pressure of water in feet due to the whole fall + that due to centrifugal force* . . . . . . . . . . . . P

7·6231 the 4th number in the 4th column of the second table contained in our last article on Barker's mill is = 95·28874 per cent. of 8, the height in feet of the column of water which actuated the water-mill, with which the fourth series of experiments was made. Or which is the same thing, let 1 be put to represent the whole height of the fall and ·9528374 will represent the available height of fall. Multiplying, therefore, equation *P* by ·9528874, we get

$.9528874\left\{h + \left(\frac{v}{8\cdot0458}\right)^2\right\}$ = *the available pressure of water in feet due h + H* . . . . . . . . . . . . . . . . . . . . Q

$\left[\frac{7\cdot853984\left[h + \left(\frac{v}{8.0458}\right)^2\right]^{\frac{1}{2}} - v}{8\cdot0458}\right]^2$ = *the pressure of water in feet due to V — v* . . . . . . . . . . . . . . . . . . . . . R

$\left(\frac{v}{8\cdot0458}\right)^2$ = *the height in feet of the pressure of water capable of maintaining the rotatory motion of the water passing through the arms of the water-mill* . . . . . . . . . . . . . . . . . . S

By adding formula *R* to formula *Q*, and subtracting formula *S* from their sum, we get

$$.9528874\left[h + \left(\frac{v}{8.0458}\right)^2\right] + \left[\frac{7\cdot853984\left[h + \left(\frac{v}{8\cdot0458}\right)^2\right]^{\frac{1}{2}} - v}{8\cdot0458}\right]^2 - \left(\frac{v}{8\cdot0458}\right)^2 =$$

*the height in feet of a column of water which would give a pressure equivalent to that which at the discharging orifices actuates the water-mill* . T

As the water-mill with which the fourth series of experiments was made is 1·3ft. diameter, this gives $v = \cdot1021018r$ = *the speed in feet per second at the centre of the discharging orifices of the water-mill;* and as those experiments were made with a fall of 8 feet, we have $h = 8$, substituting, therefore, ·1021018r for *v*, and 8 for h in equation *T*, we get

$$\cdot9528874\left(8 + \overline{\cdot01269007r}^2\right) + \left[\frac{7\cdot853984\ \left(8 + \overline{\cdot01269007r}^2\right)^{\frac{1}{2}} - \cdot1021018r}{8\cdot0458}\right]^2$$

$- \overline{\cdot01269007r}^2$ = *the height in feet of a column of water which would give a pressure equivalent to that which actuated the water-mill with which the fourth series of experiments was made* . . . . . , . . . . . U

Multiply equation *U* by ·004730412 (*a*) by 997 (the ounces weight in a cubic foot of water), and by 4·084072 (the circumference in feet which the centre of the discharging orifices of the water-mill would describe in one revolution), and divide by 10 (the circumference in feet which the point on the arm of the friction brake at which the weights were suspended, would describe if the brakes were turned round on the spindle of the water-mill, and we, after an easy reduction or two, get

$$1\cdot835393\left(8 + \overline{\cdot01269007r}^2\right) + \left[1\cdot354767\left(8 + \overline{.01269007r}^2\right)^{\frac{1}{2}} - \cdot01761197r\right]^2$$

$- \overline{.01761196r}^2$ = *the weight on friction brake in ounces* . . . . . V

As the sixth series of experiments on Barker's mill was made with the same machine and the same height of fall as the fourth, it will be evident that this formula will apply to both.

The 2nd, 4th, 6th, and 7th columns of the following table contain the results of the fourth, and most of those of the sixth series of experiments. The 3rd column of that table was calculated by formula *V*, and its 5th column by formula *B*.

TABLE 2.

| No. | Weight on brake in ounces. | | Ounces of water expended in 40 seconds. | | Revolutions of the machine in 40 seconds | Power of machine, that of the water being 100. | | Per cents. of loss caused by a portion of the power remaining in the water after it has left the discharging orifices. | Per cents. of loss occasioned by the resistance the water meets with in passing through the water-mill & pipes. | Sum of the numbers contained in the 8th, 9th, and 10th columns of this table. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Found by experiment. | Calculated by formula V. | Found by experiment. | Calculated by formula B. | | Calculated from the results contained in the 2nd, 4th, and 6th columns of this table. | Calculated from the results contained in the 3rd and 5th columns of this table. | | | |
| 1 | 29.75 | 29.36629 | 4158 | 4190.725 | 00.00 | 00.00 | 00.00 | 95.28875 | 4.71125 | 100 |
| 2 | 25.00 | 24.70995 | 4326 | 4197.897 | 41.25 | 29.80 | 30.35 | 65.23201 | 4.72738 | 100 |
| 3 | 20.00 | 19.90018 | 4809 | 4683.754 | 111.25 | 57.83 | 59.08 | 35.03064 | 5.88499 | 100 |
| 4 | 18.00 | 18.10334 | 5103 | 5099.104 | 154.50 | 68.12 | 68.57 | 24.45984 | 6.97502 | 100 |
| 5 | 17.00 | 17.14704 | 5439 | 5446.234 | 185.00 | 72.28 | 72.81 | 19.23569 | 7.95702 | 100 |
| 6 | 16.00 | 16.22552 | 5880 | 5904.883 | 221.25 | 75.26 | 75.99 | 14.65204 | 9.35363 | 100 |
| 7 | 15.00 | 15.76043 | 6216 | 6192.856 | 242.50 | 73.15 | 77.14 | 12.56829 | 10.28820 | 100 |
| 8 | 14.00 | 15.45637 | 6410 | 6403.351 | 257.50 | 70.30 | 77.69 | 11.30618 | 10.99948 | 100 |
| 9 | 10.00 | 15.00622 | 6783 | 6747.320 | 281.25 | 51.83 | 78.19 | 9.59851 | 12.21294 | 100 |
| 10 | 00.00 | 13.91447 | 7770 | 7722.702 | 345.00 | 00.00 | 77.70 | 6.29978 | 15.99913 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

The results contained in the 4th and 5th columns of the above table being nearly alike, prove that formula $B$ is correct. And it would appear that formula $V$ also is correct from the fact that the first six numbers in column 7th differ very little from the corresponding numbers in the 8th column of that table. Mr. Whitelaw thinks that when the water-mill made more than about 200 revolutions in 40 seconds, it was retarded by the one arm striking against the water which left the other, and this in his opinion explains why the 7th, 8th, 9th, and 10th numbers in column 7th, are so much less than the corresponding numbers in the 8th column of the above table. One of different sets of experiments made by Mr. Whitelaw, also tends to prove the accuracy of formula $V$. The next time we write on the subject of Barker's mill, we shall explain how the numbers contained in the 9th and 10th columns of the above table were obtained; and we, at the same time, intend to make some observations on the work on "Horizontal Water-wheels," edited by Sir Robert Kane.

## Art. IV.—PREVENTION OF DAMP IN BUILDINGS.

A very interesting paper on the prevention of damp in buildings has been published by M. Leon Vaudoyer, which we mean to make the groundwork of a few remarks on that important subject.

Damp in buildings arises from the hygrometric properties of all the materials commonly used in building, even granite imbibing moisture from a humid atmosphere; the walls of houses will therefore absorb the moisture from the soil with which they are in contact, and from the rain, which is driven against the walls by wind, or splashes against them from the ground, or which drips from the tops of walls which are unprovided with gutters, or accumulates at the lower ends of rain pipes which have no shoes. The extent of the mischief arising from the sources which we have enumerated depends in some measure on the nature of the soil and materials, the modes of construction, and the aspect of the building. Paving around a building affects the dryness of the building by carrying off the surface water, and the contiguity of sewers or drains has a similarly beneficial effect. The evil effects of dampness in houses are unfortunately too well known, as every one must have suffered to some extent from their unhealthiness, the decay of perishable articles, or the deterioration of the building itself. On the outer walls damp usually commences its injurious action with the joints, which it deprives of their cement, thus getting a lodgment in the stone which, by the alternations of heat and frost, is gradually decomposed; the humidity at this stage inducing vegetation, which greatly aids in the destruction of the materials. Cement has often been applied on the inside of walls to prevent the damp from coming through, but this prevents the access of air, and the wall having become saturated, throws off any coating which may be put on it. The use of cement applied on the outer face of the wall would be more efficacious, although not perfectly successful.

The mode of averting the inroads of damp consists in making the foundations rest on a layer of concrete, about a foot thick; and in interposing a sheet of thin lead between the courses of the masonry, or brickwork, at the level of the ground; or instead, a layer of bitumen thinly spread, or a double course of slate set in cement. This lead, bitumen, or slate, is intended to prevent the damp from rising from the footings, while the absorption of moisture from the ground next the outer face of the wall is provided against by facing the ground with stone to a depth of two or three feet; the facing to be either close to the wall or separated from it by a narrow space. The most effectual preservative of the outer face of a wall from the adjacent soil, lies in making a wide space, say three or four feet wide, between the wall and the ground facing, which may serve as a passage round the building, and afford access to cellars outside, or the space may be formed into areas, presenting a convex wall to the earth, and abutting against the wall at the springing. Openings must be made through these abutments for the areas to communicate with each other, and to diminish the surfaces in contact. To effect the due circulation of air, perforations should be made through the walls of the house near the foundation, and channels should also be made for the external air to communicate with that within the areas, which are covered over with slabs of stone to prevent the entrance of water. Immediately above these covering slabs, which should not be below the surface of the ground if it can be avoided, the wall should be faced with cement. The plastering should not be applied immediately on the walls, but on laths nailed to long narrow slips of wood secured to the wall by holdfasts. The air space thus left between the plaster and the wall prevents the communication of the damp from the wall to the plaster. The wooden floors or stone slabs forming the lower story should not be in contact with the ground; they should be supported by piers or sleeper walls, resting on a stratum of concrete, six to nine inches thick, laid over the whole surface of the house; a thin sheet of lead between the concrete and piers would be an additional security; and in such buildings as palaces, a thin layer of asphalte might be laid over the concrete. In the dwellings of the poor, however, brick piers, even without the cement, half a brick wide, and one course high, might be used with advantage; and if the floor were of stone paving, bricks laid under every joint would keep the floors tolerably free from damp. Channels, about the size of a brick, and furnished with iron gratings, should be left in walls to admit air to the floors: these might be closed by a sliding plate in the skirting when required, as in cold and rainy weather. The floors of a lowermost story should not be covered with any impervious fabric, such as oil-cloth, as the moist air which always rises through the joints of the boards from the ground, if intercepted, will speedily rot both boarding and cloth. Eave gutters and standard pipes with shoes are indispensable, as the water from eaves and water-shoots is driven against the wall, which is thereby saturated; and the want of a shoe occasions an injurious accumulation of water at the foot of the wall.

## Art. V.—NOTES OF THE MONTH.

*The Ventilation of the New Houses of Parliament.*—Dr. Reid has at length been overborne. The committee appointed to inquire into the condition of the New Houses of Parliament has just made its third report, which recommends Dr. Reid's system of ventilation to be abandoned, and a system to be adopted that is recommended by the architect; and which he says he could apply in a shorter time, and with a superior effect. This result confirms the prediction we ventured two months ago to make as to the inevitable issue of Dr. Reid's neglect to associate with himself some able practical man in the application of his system; for it could not be denied that whatever were the merits of Dr. Reid's system, he did not possess any of the qualifications necessary to put it in successful operation. The delays that have arisen in the application of his system to the New Houses of Parliament from the indefinite nature of his conceptions, and his perpetual vaccillations, were such as could no longer be tolerated. The works of the structure were standing still because he had not matured his plans; and the whole of his operations were capricious, disjointed, and wavering—as if he had assumed a task for which neither his habits nor attainments gave him any qualification. A practical man would not have come into collision with the architect, for he would have made out his plans, and have given them to the architect to embody in his own; and all this should have been done before a stone of the building was laid. If this course had been pursued, Dr. Reid's task would have been an easy one, for it would have been restricted to the simple duty of ascertaining that the works he required were properly executed. He would have been ahle moreover easily to clear himself of any imputation of having caused delays; for he would have his plans at any time to produce to show that his arrangements had previously been completed. Dr. Reid, however, appears to have fallen into the common error of overrating his own importance, and on the strength of this delusion he has loosed himself from every obligation of a man of business; and instead of addicting himself to the punctual performance of his duties, he has been dreaming away his time in the contemplation of impossible refinements. He will now, however, have to pay the penalty of these indiscretions. He has lost an opportunity of distinguishing himself which would have made the fortune of any man destined by nature to rise, and with sullied fame and distrusted capacities, he will have to begin the world anew. Such is the natural result of the elevation of men to a sphere in which they are not qualified to move. If Dr. Reid had possessed more modesty, he would have met with more success, and he would not have suffered in the estimation of any one bad his industry heen greater and his pretensions less. We shall now see what kind of ventilation Mr. Barry gives us. Whatever be its intrinsic merits it will at least be applied in a business-like manner, and that will compensate for many deficiencies.

*The Arch Controversy.*—The expectation expressed by Sir F. Trench, that the Duke of Wellington's statue intended for the arch at Constitution Hill, would be set in its place by the 18th of June, has not been realized. In the mean time, however, the clamour raised upon the subject has died away, and people appear to be beginning to think that the appropriation of the arch to the purpose intended, is not so great a violation of taste as they had supposed. The cry for precedent has been answered successfully by Sir F. Trench, who gives the arch of Marcus Aurelius at Wilton, tbe arch of Claudius Drusus, and other examples of similar combinations having already been effected, and no one hitherto has affected to designate these constructions as monstrosities. At the same time Sir F. Trench repudiates the authority of precedent in deciding such a question. To the puling men of *vertù* it is the first principle of propriety; whereas we, and those who think with us, believe tbat the first principle of propriety is fitness. Paradoxical as it may appear, we fear architects and men of lore are often bad judges of architectural subjects. Their sympathies have lost their symmetry by the undue development of some particular emotion, or by making objects representative of that emotion to their imaginations, which are objects of indifference to other spectators. The most fastidious taste is not the most just, and if it be the object of architectural beauties to impart the greatest amount of pleasure to the greatest number of persons, we believe that popular opinion will be a surer test of architectural truth than the dicta of professors and literati. We stated last month that we could see no good reason why the statue should not he placed over the arch in the manner contemplated by the committee. In that belief we still remain, and it appears to us that the public voice will confirm the justice of the opinion.

*Death of Haydon the Painter.*—Poor Haydon, the well known painter, is no more. Unable any longer to endure the indifference of the public to his finest works, and harrassed by debts wbich accumulated upon him from the small demand for his paintings, he committed self destruction by firing a bullet through his bead, and cutting his throat with a razor It is a disgrace to the country that such a man should he driven to such an extremity. We knew him well; and though eccentric and of an uncompromising disposition, wbicb procured for him many enemies, be was nevertheless one of best and kindest of human beings and full of the fire of genius. To his wife and family he was most tenderly attached, and it appears to have been in a great measure the apprehension of the distresses his embarrassments would bring upon them that drove him to tbe act of suicide. For many years he had been in the habit of keeping a diary in which all the leading events of his life were chronicled, and in whicb hc was in the hahit of recording his hopes, fears and aspirations. Some extracts from this diary were read at the Coroner's inquest, hy which it appeared that the late exhibition of his picture, "the Banishment of Aristides," at tbe Egyptian Hall, not only failed to yield him any profit, but was attended witb considerable loss; and that whereas during an entire week his picture had only 133 visitors, Tom Thumb's levees, which were held in another part of the same building, were attended by upwards of 12,000 persons. He had looked forward to the exhibition of this picture as a means of retrieving his affairs, and when that hope failed him, his only prospect was a prison. In the hour of bis distress he wrote to Sir Robert Peel and to some otber persons whose names have not transpired. From none of these did he receive any answer except Sir Robert Peel, who immediately wrote back enclosing 50*l.* for his present relief. Nor did Sir Robert Peel's kind consideration end here. Immediately after the lamentable event occurred, he sent 200*l.* to Mrs. Haydon from the Royal Bounty Fund, in order that the family might suffer no privation until a public appeal could be made in their behalf. Sir Robert Peel may well be envied the satisfaction whicb such acts of benevolence must bestow; and that a man weighed down by the cares of a great empire, and worried by a swarm of venomous detractors, should nevertheless find time to respond to the appeal of a neglected artist, and render with alacrity the aid which others withheld, cannot fail to win for sucb considerate attentions the public gratitude and admiration. These acts of grace however are the rule with Sir Robert Peel and they must bring a satisfaction and earn a sterling fame, of which no accidents can deprive him. Mr. Haydon was a man of great industry, temperate in his habits, and religious. For nearly bis whole life he had been a vebement opponent of the Royal Academy, and insisted on the necessity of many reforms in tbat institution. His lectures on art were always listened to with interest, and were interspersed with anecdotes of eminent painters and literary men of his acquaintance, which gave them additional zest. As a painter he was distinguished by the grandeur of his conceptions, which sometimes degenerated into exaggeration, but often rose into sublimity. He pursued the vocation of historical painter for many years under great discouragements, and be is the last of the race.

*Baths and Washhouses for the Labouring Classes.*—We have visited the baths and wash houses for the labouring classes, recently constructed at George-street, Euston-square. The object is one that must gain universal approbation, but we do not think the approbation can in this instance be extended to the manner in which the project has been put in practice. The building is of considerable extent; and though the plan is confused and irregular, the room we think has been turned to the best account. But the whole of the structure has a very lath and plaster air, and it is impossible if it be resorted to by any considerable number of persons that it should be distinguished by any great durability. In the apartment in which the wash-tubs are situated, the roof is very low, and there is but an imperfect ventilation: the fitting of the batbs are fragile and temporary, and the whole of the arrangements about the building are better adapted for the fourth story of a London dwelling tban for a public edifice where the wear and tear must be great, and where everything onght to be of the most substantial description. We regret to be compelled to adopt this censorious vein, but those who visit these baths and washhouses will find tbem to represent the real facts of the case, and wc see no need for confounding the qualities of the edifice with tbe merits of the cause.

We were sorry to find but few visitors on the occasion of our visit to these baths. The public may, perhaps, he deterred by the custom of pushing a subscription box into the face of every one entering the place—an indecorous custom as we conceive, and one not calculated to be of much service. People do not like to he entrapped into an admission fee, which this practice virtually becomes, and are disgusted by the huckstering hy which a great cause is sought to be supported. There will be no lack of funds if proper appeals to the public he made; and those distinguished persons who have lent their countenance to the undertaking should prevent the zeal of underlings betraying them into courses that bring neither money nor respect.

*Supply of London with Water by means of Artesian Wells.*—A company, we observe, has lately been started with a capital of 2,000,000*l.* as a beginning, for supplying Southwark with water by means of Artesian wells, and a meeting of the inhahitants of Southwark has been lately held, at which the plan of the projectors was explained. We drew attention to this method of supplying London with water in the ninth number of the *Artizan*, and the results obtained from the sinking of the well at Trafalgar-square, and other analagous operations have, by the testimony of experiment, confirmed our prediction. On a visit we paid to the pumping engines behind the National Gallery during the late hot weather, we found the water to be raised from the well in undiminished quantity: it was very cold, was pure and palatable, and was greatly coveted by the persons in the neighbourbood who sent their pitchers to obtain a supply. The chalk formation lying below London contains large quantities of water of the purest quality, which bas only to be pumped up to supply all the wants of the population. But the practical question remains in what way may this be most satisfactorily done? and this we shall now endeavour to indicate.

Altbough the chalk lying under London contains vast quantities of water, it does not part with the water very readily; and in the case of wells from wbich a large supply of water is required, it is necessary to drive adits to obtain a large amount of infiltrating surface. Artesian wells, in which the water rises to the surface can very rarely be successfully bored into the chalk, chiefly in consequence of tbe great thickness of the chalk formation. Tbe rain, nevertheless, which falls on the tract where the chalk rises to the surface, filters through the chalk, and descends until it meets with an impervious stratum of rock or clay; and the rain which falls on the chalk districts around London, and which extend over several counties, find their way into the London basin, and saturate the chalk under pressure. Taking the quantity of rain which falls in the year at the low average of 24 inches, each acre of chalk country thus drained, would add 500,000 gallons a year to the great reservoir heneath London; and the drainage of the single county of Hertford, would supply water sufficient to meet the demands of twice the population of Great Britain. There can be no deficiency in the supply of water therefore entering the London basin, and the chief question which remains is at what depth it may be reached It appears to us that it is only necessary to penetrate to a small depth below the rim of the basin of impervious material underlying the chalk, to obtain a never-failing supply; for tbe water in the well cannot sink below that level, or the level of the rim of the basin it overflows. At Chelsea, as was mentioned in our former remarks upon tbis subject, a well was sunk to a depth of 394 feet, in which the water rose to a height of 200 feet from the bottom, from which it would appear that the standing level of the water in the chalk had been reached, and if the standing level of the water be reached, a single well will yield any quantity of water. A few engines, and a few artesian wells therefore distributed over London would enable the people to obtain good water instead of the nauseous element they are at present condemned to use it, and it would be hard to specify any greater measure of amelioration. The accessibility of good water would give a great impulse to the temperance cause, for people are driven to beer-bibbing by the badness of the water, which is really in many cases unfit for human use. We trust the company at present projected will meet with zealous support, for we know of no undertaking which has a better claim upon the public sympathies.

*The Steamer Ariel.*—This is a vessel constructed by Messrs. Ditchburn and Mare for the Peninsular and Oriental Steam Company, and fitted with oscillating engines by Messrs. J. Penn and Son. The form of the vessel is well adapted for speed, and the engines are distinguished by the symmetry and beauty which characterize Messrs. Penn's productions. The following are some of their dimensions:—Diameter of cylinder 68 inches; length of stroke 4 feet 6 inches. There are four boilers, of which two stand before and two behind the engines:—length of boiler 9 feet 6 inches; breadth 11 feet 7 inches; height 9 feet: length of tubes 7 feet; diameter of tubes $2\frac{3}{4}$ inches. The boilers are fitted up with Mr. Lamb's blow-off apparatus, of which we made mention last month.

*Engineers of the Navy.*—The Admiralty do not appear to have been much more successful in securing subordination among the engineering apprentices of the navy, than in attracting into their service engineers of ability to manage the engines of the numerous government steam vessels. The school of engineer apprentices on board the *Sulphur* at Woolwich has lately been broken up, its occupants having become too unruly, it is said, for the superintendent longer to manage: but the fault of such a catastrophe is rather attributable to the austerity of the Admiralty rule than to the presence of those few refractory spirits who have been the ringleaders on the occasion. Engineers cannot be dealt with in the manner sailors have been dealt with from time immemorial: they are a perverse and democratic race, with whom kindness may do everything, and severity nothing; and, in our judgment, they are to be honoured for their resistance to the humiliations by which ordinary seamen have for centuries been degraded. They know very well that in most of the qualifications which entitle a man to honour, they are the equals of those who hold themselves vastly above them—perhaps sometimes their superiors: and they have never been accustomed, and will not now begin, to disguise the perception of their just deserts. The days of the martinets are gone: other inducements than they offer must now be presented, and among engineers, at least, the only fruits of severity will be failure and alienation.

*Railways in Belgium.*—The railways of Belgium are, we conceive, not without some interest to the people of this country, inasmuch as they exhibit the benefits arising from a vigilant supervision of the companies in whose hands the management of the railways is placed. The central government interferes in case of any accidents occurring, and punishes the culpable, while it also provides against a recurrence of the evil. It is urged by some that the low state of practical science in Belgium, and the general ignorance of the public, as compared with England, afford some just reasons for opposing the introduction of such a system in this country; but even admitting, what is by no means certain, that the public intelligence is superior to that of Belgium, we do not see that it justifies the rejection of a system, the tendency of which is to protect the public against the consequences of corporate rapacity. In Belgium and other continental countries, where the railways are little subject to the risk of competing lines, the government, which thus protects them, has an especial title to control them and provide for the interests of the public; but in this country also, the privileges conceded to a railway company are so great, as to justify the government in demanding that those immunities shall not be used in a manner detrimental to the general good.

The operation of the railway arrangements of Belgium has been highly satisfactory, as evinced by increased receipts both in the passenger and merchandize departments, although the latter exhibits the greater increase, the per centage on the total amounting in 1840 to 24 per cent., in 1841 to 34 per cent., in 1842 to $36\frac{1}{2}$ per cent., in 1843 to 39 per cent., in 1844 to 45 per cent., and in 1845 to 49 per cent. The total receipts amounted in 1844 to £449,216; and in 1845 to £496,128, showing an increase of fully 10 per cent.

*Irish Railways.*—We have never been friendly to Irish railways, for the simple reason that we did not believe they would prove profitable investments, and because we considered a more productive employment of capital in that country could easily be found. Our anticipations on this head, are, we find now being realized. Completed railways do not pay, and railways in course of construction are unable to obtain the funds necessary for their completion, and are obliged to apply to the Government for help. The government, we suppose, will have to render this assistance; and, although we raise no objection to a partiality being shewn to Ireland in this respect, we do object to schemes being puffed off as certain to produce a golden harvest, which are no sooner tested by experience than they prove themselves to be barren and unprofitable. Whatever money, however, the government may be disposed to expend in Ireland will not, if expended in railway works, be expended with the greatest benefit. The reclaiming of bogs, the introduction of better systems of drainage, and other analagous operations, would both be more profitable at the present time, and would furnish the population with increased employment for the time to come. It is sufficient for us here, however, to repeat our conviction, that Irish railways will, in most cases, prove bad speculations to the persons engaged in them. There is too much poverty in the country to enable railways to thrive; and, as we predicted on a former occasion, the same fate will, in all probability, overtake them, that long ago overtook the canals.

*Naval Construction.*—The supremacy of the Surveyor of the Navy seems to be terminated, and a salutary restriction has been put upon his authority. A board has been appointed, entitled the "Committee of Reference," which consists of Dr. Inman, Professor of Mathematics to the late Royal Naval College, and to the late School of Naval Architecture; Mr. Abethell, Master Shipwright at Pembroke Dockyard, and formerly a pupil of the School of Naval Architecture; and Mr. Fincham, Master Shipwright of Portsmouth Dockyard, and formerly the practical preceptor of the students of the School of Naval Architecture. We are glad to see that the labours and the patience of those connected with the late School of Naval Architecture have not been without their fruits, and that they have at length succeeded in vindicating their claim to consideration. It was no doubt discouraging to find themselves discarded to make room for one who might be expected to know more respecting the working than the construction of a ship; but their victory is the more complete, since their supplanter has had ample time to demonstrate his own inefficiency. We are sorry to see in some papers an attempt to derogate from the respect due to the talents of Mr. Fincham, who is represented as a mere practical shipwright, and therefore only competent to play a secondary part with such distinguished mathematicians as Dr. Inman, and Mr. Abethell. Although we look with much favour on the efforts now in progress to reduce naval construction to a science, and regard the appointment of those gentlemen as calculated to advance that desirable object, yet we are not by any means satisfied that a philosopher, fresh from his closet, would make so good a ship as many carpenters of but slender pretensions to learning. In proof of this allegation, we could easily urge numerous examples, but will content ourselves with saying that the best steamers, and some of the best sailing vessels now afloat, are not indebted to high mathematical knowledge for their good qualities. The fact seems to be that ignorant praters, who should never have appeared in print, having been bewildered with the accuracy of deductions in other branches of science which have been more assiduously cultivated, have prostrated themselves in blind adoration before anything which assumes the name, losing sight of the important truth that science is not mere abstract speculation but the methodical expression of natural laws deduced from the observation of facts; and that without these facts science is a mere disembodied spirituality. The science of naval architecture is at present in an imperfect state, and close observation and careful investigation will be required to supply its deficiencies. For this purpose mere mathematicians are not all sufficient, but with men of experience to supply them with data, they may be expected to methodise the disjointed facts into a harmonious scheme. In this light, then, we regard the appointment of the "Committee of Reference" as a highly judicious one; and are not without hopes that they will elicit much good even from the blunders which of late have been so freely perpetrated. Still they must guard against the opposite error to that alleged against the intuitive theory; for shipbuilding is partly a fine art, and cannot be reduced to a string of dogmas.

*The Iron Gun Brig "Recruit."*—This is an iron 12-gun brig, recently completed by Messrs. Ditchburn and Mare of Blackwall, for the Admiralty, and from which great things are expected. The following are the principal dimensions:—Length between perpendiculars 113 feet; length of keel for tonnage, 94 feet 10 inches; breadth, 30 feet $5\frac{1}{2}$ in.; depth of hold, 14 feet 2 inches; burden in tons, 449 46-94. The Recruit is an experimental vessel, and the result of her trials are looked forward to with much interest. Her sailing qualities will be tested by a competition with the wooden gun brig Contest, built by Mr. White of Cowes. The model is a very handsome one. The draft of water aft will be about 14 feet when the vessel is in trim.

*The Iron Steam Ship "Erin."*—This is an iron vessel belonging to the Peninsular and Oriental Steam Navigation Company, recently launched from the building yard of Messrs. Ditchburn and Mare of Blackwall. Her dimensions are: length between perpendiculars, 201 feet 6 inches; length of keel for tonnage, 184 feet; breadth for tonnage, 28 feet 9 inches; depth in the hold, 17 feet 4 inches; and burthen in tons, 810. The engines are in progress of construction by Messrs. Maudslay, and are of the double cylinder kind. The power is 200 horses. On the occasion of the launch a *dejeuner* was given by the builders, at Lovegrove's tavern, at Blackwall, at which some of the most eminent engineers and ship builders of the metropolis were present.

*The Croydon Atmospheric.*—The Croydon atmospheric railway is not doing well. Ever since it was opened, the engins constructed by Messrs. Maudslay have occasionally been breaking down whereby the atmospheric apparatushas been disabled, and the use of a locomotive has become necessary. The late hot weather has revealed another weakness. The composition of wax and tallow by which the valve has been closed, has been melted by the heat of the sun, and by the force of the vacuum sucked into the pipe, so that it has been impossible to prevent such an amount of leakage as rendered, the apparatus unserviceable. There is nothing very serious in these defects and they admit of an obvious remedy; nevertheless, the frequent occurrence of such accidents will discouragee the use of the atmospheric system, as they carry the suggestion that the scheme is still immature.

*The "Blasco Garay."*—This steam vesssel of which we gave a slight account last month, continues by her performances to support the high reputation she has earned. Shortly after our last notice was written she proceeded to Spain, and with all her coals and equipments on board, and with a deep draft of water, she realised a speed of 13 statute miles per hour. The engines made 19½ revolutions, and worked with great ease and sweetness; and there was no tremulous motiou perceptible in the ship. The vessel reached Cadiz from Blackwall in 121 hours or 5 days 1 hour, although the winds upon the whole were adverse. The engines of the *Blasco Garay,* we may repeat, were constructed by Messrs. Miller Ravenhill and Co., and the vessel was built by Mr. Wigram.

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## ART. VI.—NOVELTIES IN ART AND SCIENCE.

*Discovery of an Invisible Planet.*—A Paper has been read by M. Leverrier before the Paris Academy of Sciences relative to the existence of a planet which has never yet been seen by the discoverer, or by any one else, but which will make its first appearance on the first of Jauuary next. This wonderful visitor has given intimation of its existence by the perturbations which it has occasioned among the more familiar planets, and which at length led M. Leverrier after an examination of the observations on Uranus, which have been made since 1690, to deduce the existence of another planet twice the distance beyond Uranus, that Uranus is from the sun. If this should prove well founded the discovery of M. Leverrier will place him at the head of all scientific discoverers, since to him will belong the honour of discovering a planet which cannot be seen.

*Institution of an Academy of Sciences at Vienna.*—The desire long entertained by the learned of Vienna for the establishment of an Academy of Sciences in that capital has, at length, been gratified. The royal mandate has gone forth for the formation of an "Imperial and Royal" institution of the kind—His Majesty, uevertheless, reserving to himself a rather larger power over its proceedings and government than seems propitious to free discussion. The academy is to consist of four classes—the first, of the Natural and Medical Sciences;—second, of History;—third, of Languages;—and fourth, of Belles Lettres. Philosophy is excluded, we suppose, because she deals with unpalatable truths. Each class is to have twenty-four resident, and an unlimited number of corresponding, members. The resident members are to to have the title and rank of government councillors; and to be named in the first instance by the emperor. Afterwards, each class will elect members to fill its own vacancies;—but the choice must, in each case, be submitted to the emperor for his approbation. The emperor is to appoint a curator, too, of the academy; ranking above the presidents of classes—as in the Academy of Fine Arts in the same capital. The new institution is to be installed on the day of inauguration of the late emperor's equestrian statue—at the. close of the present or beginning of the next month. We can hardly anticipate much benefit to science from such an institution, as with the checks imposed by the emperor at every turn, there cannot be much independence of thought. If the emperor had been actuated by a regard for science, he would have given her his aid without encumbering her with his protection.

*Manufacture of Paper in India.*—At a late meeting of the Asiatic Society, a paper was read by Captain Postans, descriptive of the processes of an Indian paper manufactory. The skill and science of the English paper makers have nearly driven the Indian paper maker from the field, yet, in remote and inaccessible districts the manufacture is still carried on in the primiture fashion which distinguishes the processes of all the arts in India. Captain Postans, in a journey through the Dekkan, found a village or small town wholly occupied in the manufacture of paper. This place is near Rozah, and is named Kharguzpore, or paper-town. It is of small extent,—not exceeding fifty houses, all occupied by paper-makers. One of the head men of the place conducted Captain Postans through his establishment, and explained the whole process. The principle of the manufacture in nowise differs from the old European mode,—with the modifications rendered expedient by difference of climate and material. The material is the ordinary coarse hempen bagging used by the *bringarries,* when torn to rags in their service. These rags are cut into small pieces, and thoroughly washed in the numerous tanks which surround the town,—the water of which is said to be peculiarly fit for the purpose. The tanks are always quite surrounded by workmen, employed in washing, bleaching, and drying the rags; which, in about 12 days, are converted into a white pulp, and then made up into balls weighing about 4 lbs. each, and as big as a man's head. These balls are subsequently mixed with water in a small tank; and then made into paper upon a frame, precisely as in the old European mode except that the frame is made with fine reeds instead of brass wire. A, man and boy are employed in making the sheets, which are removed by a third work-man, who first presses them under large stones to expel the moisture, and then plasters them against the walls of the manufactory to dry in the sun. The paper is afterwards covered with a gummy size, and polished by rubbing with smooth stones.

*Rivers Rendered Poisonous by Sewers.*—An inquest has reeently been held in Limerick, on the bodies of three seamen; and the jury gave a verdict, founded on the evidence of seamen and medical men, that the deaths had been caused by drinking the water of the Shannon, which the drainage of gas works and the common sewage had rendered poisonous. We trust that this unfortunate event, will induce the authorities of Limeriek to take measures for applying sewage to the legitimate purpose of manuring the ground, instead of allowing a valuable material to go to waste, and to poison the waters of their river.

*Gold in Siberia.*—It is stated, in a French scientific paper that Siberia contains gold in such abundance, that its discovery is likely to produce a financial revolution in Europe, similar to that which took place on the discovery of Peru. In the period of the last fourteen years, the produce of the gold mines in that country is said to have doubled. Eleven thousand persons are daily employed in washing the mineral; and three times the number could be so occupied if the hands could be found. Nothing but this want of labourers, it is added, prevents the markets of Europe from being filled with the gold of this rich deposit.

*Painting on Lava.*—The Paris journals devoted to art, give an account of a painting by M. Jollivet on lava—a substance hitherto, it is observed, used in that capital only for the names of streets and numbering of houses. M. Jollivet has been suc essful in painting upon that volcanic substance pictures of large dimensions, by a process analogous to that of painting on enamel. One of these is about to be placed on the exterior wall beneath the portico of the Church of St. Vincent de Paul. Painting on lava says the *Moniteur des Arts,* should be encouraged as monumental painting; seeming to have over every other kind the advantage of an indestructible solidity. Certainly enamel painting is the most indestructible of any, but the materials with which the painting is executed affect the question, as well as the material on which the painting is made.

*New Gas Burner.*—A novel species of gas burner was lately exhibited before the Institution of Civil Engineers, in which the principle feature of novelty was the introduction of a stream of air to the centre of the flame by means of a hollow button in the middle of the burner. The air passing up through the hollow stem of this button, was heated, and passed out by two series of fine holes around the periphery; and impinging with some force upon the flame of the gas, curved it outwards in the shape of a tulip,—while the oxygen of the air mingliug with the carburetted hydrogen gas produced a very perfect combustion. The flame was quite white at the top of the burner, and it was very steady—as was demonstrated by the excellent light in the theatre of the institution, where these burners have been used for some time. It was stated, that, in comparing the consumption of these burners with that of the concentric burners, and trying the power of the two lights with the photometer, the new burner gave a better light, with a saving of more than one-third of the gas consumed,

*Paper from the Banana Tree.*—At a late meeting of tbe Paris Academy of Sciences, a communication was received from M. Roque, on a project for manufacturing paper from the fibres of the banana tree. It appears that experiments have been made under the eyes of a commitee appointed by the Minister of Commerce, and that some very white and good paper was produced. It is proposed by M. Roque to carry on this operation in Algeria, not merely as regards the banana tree, but also the Alves and other textile plants; and it is said that a large grant of land has been made to him in the colony for that purpose.

*Locomotive Carriages Propelled by a Spring.*—In a letter to the Mining Journal, Mr. R. Mushet asks—"Why not employ the force of a large steel spring, similar to the spring of a watch, to put in motion a railway train? The spring might, from time to time, be wound up by the power of small stationary steam engines; and as watches will go for twenty four hours without winding up, why should not a locomotive, furnished with a similar source of power within itself go for an equal space of time? Those who have seen and understand the construction of common musical snuff-boxes, will readily comprehend how the force of a spring may be made to communicate to the driving wheels of a locomotive any required degree of velocity; the little fly-wheel, or fan, of the box revolving at a rate far greater than would ever be required in railway locomotion." We answer to this enquiry that the scheme is impossible, because no spring could be obtained capable of becoming the depository of sufficient power, to maintain the speed of railway train for any considerable distance. A locomotive, it may be added, even of very moderate capabilities, exerts a power of 100 horses; and therefore if a spring were to be made of equivalent power to maintain the motion for 24 hours, it would require an engine of 2,400 horses power acting for one hour to wind it up.

*Conical Rifle Balls.*—Some experiments have been made at Woolwich, by Mr. Lancaster, with rifle balls of a sugar loaf form. The distance of the target was 1200 ft.; and with this range the balls, which were 1¾ ounces in weight, carried very fair, struck through the 2 inch wooden target and buried themselves some inches deep in the earth, without alteration of form. Mr. Lancaster states that this shape of ball requires less windage than one of a spherical form, which loses much of its force in revolving on its own axis. The day on which the experiments were made was rather stormy, but the results are considered so satisfactory that it is intended to repeat them with six pounder guns.

*Machine for Destroying Fleets.*—An American paper gives the following grandiloquent account of a contrivance for destroying ships recently perfected in that country—" One of our enterprising young men has invented a machine which is called " The Leviathan," for the purpose of destroying vessels of an enemy in the time of war. It moves from 10 to 15 miles per hour far below the surface of the ocean. Not a ripple is seen on the water, as it approaches the vessel doomed to destruction. No warning is given. No moving, living thing may be within the bounds of the horizon. In a moment—" in the twinkling of an eye" the work of destruction is accomplished, and the strongest vessel on the ocean is shattered into ten thousand fragments. All on board must inevitably perish. In a moment " the Leviathan" insatiable as the " Giant King of Terrors" is on its way to another object of its destruction. It is cheaply constructed and can be navigated with very few men, and those as perfectly safe as if they were thousand miles from the scene of action. Each machine is capable of destroying 5 vessels per hour, of any magnitude. This scheme resembles in its operation Fulton's torpedo from which such wonders were expected forty years ago and is probably in its essential features a revival of that well known scheme. Fulton's torpedo proved itself to be a most destructive instrument when exploded beneath the bottom of a ship but the difficulty was to get it there, and this difficulty has never been surmounted. We think however, that more destructive instruments of warfare than any now known, will be discovered and used, should a European war again take place, but the use of snch instruments cannot be retained by any particular country, and the most they can can do is to give the nation that first uses them a temporary advantage.

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## Art. VII.—ENGINES OF THE "BULL DOG" AND "OBERON."

The engines of the *Bull Dog*, of which we now give a plate, are a very favourable specimen of direct action engine, and do much credit to Messrs. Rennie, by whom they have been manufactured. Each piston has two piston rods connected by a cross-head as represented in the plate; of this cross head a portion projects downward into a recess in the cylinder cover and to this lower portion the end of the connecting rod is attatched. The piston is recessed in the centre to answer the recess in the cover and the piston rods are suitably guided by means of a paralled motion. The design of the two piston rods and the recessed piston, is to obtain a greater length of stroke or a great length of connecting rod with the same height of shaft; and this end is attained. There are but two columns for supporting the paddle shaft proceeding from each cylinder, instead of four as is the usual practice: a very strong frame of cast iron rests on top of these columns. in which the shaft plummer blocks are cast, and these plummer blocks overhang the columns considerably. The engines are provided with the pulleys and traps now generally employed for disengaging the paddle wheels. The slide valves are wrought by means of the link motion which we described in noticing the different kinds of expansion gear in the last number of the *Artizan*; but the design of the contrivance in this application, is not to work the valves so as to expand the steam, but to enable them to be moved by hand with facility. The engines are never thrown out of gear in the usual manner but by shifting the link until the pin of the valve lever comes into the centre of it, the valve is brought to rest with both ports closed, or by shifting the link so that the pin comes to its opposite end, the motion of the valve is reversed. The use of the link motion gives the engineer a great command of the engines, for it enables him to reverse them instantly without throwing the engines out of gear. The contrivance might, however, we conceive, be so simplified as to dispense with the use of the second eccentric rod and eccentric; which, in a large engine, is a considerable addition.

The engines of the *Oberon* are of the oscillating kind, and closely resemble in every respect the engines of Messrs. Penn. The workmanship of both sets of engines is of the very first quality, and no expense or labour has been spared to make them first rate specimens of engine work. The whole of the details are regulated by a sound mechanical knowledge, a refined taste, which is, perhaps, sometimes needlesly fastidious, and a perfect appreciation of the qualities which give efficiency to the machine.

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## Art. VIII.—THE BUILDINGS AND MANUFACTURES OF FEZ.

In a former number of the *Artizan** we gave some information respecting the mechanical arts of Morocco which was furnished to us by a person who had spent many years in the country, and was well acqainted with its productions. We now add from the same source some remarks respecting the the buildings and manufactures of Fez, the capital of the empire, and the chief seat of its present manufactures; and as Fez is inaccessible to Europeans, the information we have to give will probably be received with some interest. In the reign of Sidi Mahommed about a century ago, Fez was the residence of some Portuguese and Spaniards, from whom the information respecting it which now passes current in books of geography and gazetteers has been derived; but no European can now visit Fez except as an ambassador, and then it is impossible for him to see anything in the place.

Fez consists of two parts called old Fez and new Fez, of which new Fez is the abode of Jews, and imperial troops, while old Fez is inhabited by Moors, and in it the chief manufactures are situated. The old and new towns stand about half a mile apart; they are each surrounded by walls; and a strip of land laid out in gardens, lying between the towns is also walled in, so that the towns may be said to communicate with each other within the walls. The walls are formed of concrete, and in some places are very thick and high, but in a military sense the place is not a strong one. A river passes by new Fez, and passes under old Fez, the houses over the river being built on arches. At the gate of new Fez is a large noria or wheel for raising water for the supply of the town, which is turned by the current of the river. The wheel in revolving makes a melancholy sound like the wooden axles of the bullock carts in Lisbon. The Moors say it sings for Mahommed. This noria is a very old machine: it appears to operate satisfactorily, and to require but little repair.

The water from the noria is conducted through the town in earthenware pipes, which are joined together by a cement formed of lime, soap and oil, mixed to the consistency of putty, and mingled with chopped tow to bind it together. The question of the applicability of earthenware pipes for the conveyance of water has been agitated in this country at different times; but the point is in reality set at rest by their extensive use for that purpose in oriental countries, although the quality of the pipes there used is very inferior. The head of water sometimes too, is as great as any that is employed in European countries. In new Fez, however, on one occasion, many of the pipes were destroyed by the roots of the trees growing in the ground through which the water passed, but the evil was remedied by removing the trees and plants in the line of the pipes.

The sanctuaries and mosques of Fez are numerous and of a large dimensions, and some of them are of considerable beauty. The Jamma el Finna is the largest of the Mosques and the most ancient: it is constructed after the same fashion as the Mosque at Cordova, and the roof is supported by 365 pillars of marble. It has two towers and seven gates, but it has now lost much of its ancient splendour and is hastening to decay. The sanctuary of Muley Idris is nearly as ancient as the Jamma el Finna, and is in much better perservation. The floors and walls of this building are covered with glazed tiles of different colours, with which Moresque devices of great beauty are wrought out. The building is several stories high. Water is conducted to the top of the building in pipes, and descends into the different apartments in which are marble fountains. The sanctuary of Muley Idris is the Westminster Abbey of Fez. In it most of the eminent schereefs and other great men of the country are buried, and it is reckoned an honour and priviledge to be thus distinguished. The tomb of Muley Idris himself, is situated in a species of chapel. under a small dome; around are stone benches on which the persons may recline who come to pay their devotions. The tesselated work formed with the small coloured bricks is very rich and beautiful. The climate is propitious to such a style of decoration, and there is no smoke to soil it. For the finer descriptions of work the bricks are not more than half an inch square.

There are a great number of flour mills in Fez, which are driven by water. These mills are very rude in their construction, but they are simple, and operate with tolerable efficiency. The water, spouting from a stationary jet, impinges against the spokes of a small wheel, like a cart wheel without the rim, which revolves horizontally, the ends of the spokes being widened and scooped into a spoon-like form, the better to receive the impact of the water. To the upright spindle of this wheel the revolving mill-stone is attached, so that each pair of mill-stones require a water wheel for themselves. About fifty mills are situated at one place upon the river, the water of which gives motion to the whole of them. The Fez flour is celebrated throughout the country for its excellent quality, and much of its superiority is attributed to the efficiency of the mills.

The chief manufactures of Fez are red caps, haycks, thick silk and woollens, striped cotton cloths, damask sashes of silk and gold, gold embroidery, Morocco leather and shoes, painted china, the colours of which are not burnt in, but may be scraped off by a knife; glazed bricks of brilliant colours, muskets, saddles and bridles, and stirrups and spurs. These latter articles are frequently elaborately chased, and inlaid with silver; there are also swords, jewellery, armlets and anklets of gold and silver, amber beads, mats, straw caps, and baskets. Morocco leather is largely made and some of the dyes used for silk and cotton are extremely rich and brilliant. The artificers of Fez are reckoned the most expert in the whole country; many of them are Jews, and by the Jews the working of gold and silver, and the manufacture of jewellery, are almost wholly monopolized. By them also the money of the country is coined. The pieces of gold or silver having been hammered out to the right thickness, are clipped into pieces of the right weight, and of a roundish form. Each piece is then stamped by a punch.

Some of the silk manufactures of Fez, rival those of Damascus, but the looms by which these fabrics are produced, are of the rudest description; and much time is consumed in the manufacture. Since Algiers was taken by the French, a number of Algerines skilled in gold embroidery, have taken up their residence in Fez, and there is a barbarous magnificence in

* Page 187, vol. ii.

their produtions, which causes them to be held in high estimation by a barbarous people. The shops of Fez are like the other shops throughout the East—mere small dens in which the merchant sits cross legged to sell his goods which are all within his reach. It would be dangerous in these shops to make any great display of wealth, as the shop would probably be pillaged, and the occupant murdered, by the wild people who come into the town on the market day.

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## ART. IX.—PROGRESS OF ORNAMENTAL DESIGN.

At a late meeting of the Archæological Institute, Mr. Birch offered some remarks on the causes which have influenced the general character of *ornamental design*, as distinct from *art* on the one hand and mere *manufacture* on the other. He observed that the earliest ornaments of every race were doubtless some natural production—flowers, leaves, berries, amber, ivory, shells, minerals. Afterwards, as skill in metallurgy and other arts increased, these substances were imitated in some more convenient material. The types of the original objects, thus becoming perfectly familiar to the race, would exert a considerable influence on the character of their ornamental design for many generations. Again, the primary substances thus employed were replaced in the progress of wealth, commercial intercourse, and mehanical skill, by more esteemed or abundant materials. From the influence of habit, the class of ornament proper in one material, was retained improperly in another—though sometimes with very felicitous effects. Thus, the ornaments of the earliest Greek and other fictile vases seem imitations of the basket-work of an earlier generation; the glass necklace of the Celts was copied in the metallic torques. This process of irregular adaptation is probably always going on in the art of a race—like irregular formations and self-adjustments of their language.

In that subsequent period of the history of a race when architecture, sculpture, and painting, are distinctly and fully developed, these arts have exercised a great influence over the contemporary ornamental design. As the principles of design became more clearly understood, the love of imitation common to man led to the introduction of the forms of nature in ornamental design. This was not, as in the first efforts of the savage, the mere reproduction, in a new material, of animal and vegetable substances, but the artistic representation and adaptation of animal and vegetable life. The process seems to have been as follows:—In the fashioning of any object intended for use, the dictates of a common necessity have given birth to much the same type in the productions of races the farthest apart in date and situation; but, after the fulfilment of the primary want, there arises the desire to adapt, in the structure of the object, analogous forms from vegetable or animal life, and to incorporate the work of nature and of man into one design. The Greek race appears to have possessed extraordinary natural capacity for carrying out this love of imitation. An intuitive tact led them to discern in nature, and borrow in art, the forms best suited for the required design. A never-failing sense of beauty shaped these selections into harmonious composition, and their practical genius kept always in view the prescribed material and the prescribed form,—the conditions subject to which work was to be executed.

The principles of artistic imitation having been acquired by the artizan in the school of the great sculptor or painter, his general principles of composition would be further regulated by the same masters; that is to say, if the compositions of the great artist of a particular race and period were contained within a certain range of lines, with more or less of flow, intricacy or simplicity, the same characteristics may be distinctly recognised in the ornaments produced by the artizan of the same race and period. In some cases we see the mouldings and decorations of architecture directly borrowed, as in the Mæander and other patterns of the Greek robe.—The character of ornamental design would be further influenced—1. By the desire te imitate the exotic fashions and patterns introduced by commerce from other countries. 2. By the associations of religion, certain forms because originally symbolical, were adopted in the fashion of articles of household and daily life, and retained long after the meaning of the symbol had been forgotten. It has been the great difficulty of the archæologist to discern when the symbol was first employed as such in ornament, and when it became purely conventional.

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## ART. X.—LETTERS TO THE CLUB.

*Water-Space Boilers.*—In your last number you say the arrangement of tubular boilers, recommended by Mr. Johnstone, with water within the tubes, has been adopted by Mr. David Napier in several steam-vessels now plying upon the Thames. A statement of a few of the faults of Mr. Napier's plan of boiler, and some facts as to the means that have been tried to overcome these faults, I think will convince you that that plan of boiler in its practical details is very different from the plan of tubular boiler I recommended, although both those plans of boiler have the water within the tubes. First, the boiler which I recommended had the tubes placed in a chamber behind the furnace, whereas Mr. Napier's tubes are placed above the furnace, and consequently the steam produced about it passes up through the tubes, an arrangement which is most improper; the tubes at their lower extremities ought to be supplied with water, not with steam. Second; five or six steam vessels on the Clyde have been fitted with Mr. Napier's patent boilers by Messrs. Smith and Rodger, Glasgow; these gentlemen experienced a great deal of annoyance from the first boilers they made on this plan; they primed excessively, and the water level in the glass gauge could not be depended on, as the real level of the water in the boiler, besides being very unsteady, fluctuating from the top to the bottom of the glass tube with great rapidity. Messrs. Smith and Rodger have improved these boilers greatly; in fact, their improvements have rendered those boilers fit to be worked on board a steam vessel. In the plan and specification of Mr. Napier's boiler, as originally designed, you will find there is a small water space external to the boiler, which extends from the top to the lower part of the boiler; through this small space Mr. Napier expected that water would descend in sufficient quantity to supply the tubes at their lower extremities; but in this expectation he was in error; the area of that descending water space, as constructed in the first boilers, was not a tithe of the total area of all the tubes and water spaces which are ascending, or steam producing water spaces in that plan of boiler. Mr. Napier seems to have thought as I have heard some engineers express themselves—"that although the descending water space is of less area than the ascending, yet a sufficient quantity of water will get down the descending water space; for if a current is produced in the boiler, the water, in order to supply that current, will just have to run a little faster down the descending space, and the rapidity with which it will descend will make up for the deficiency of area in the space." This reasoning is erroneous: they forget that the prime mover or originator of the current is the gravitation of the water in the descending water space, and the gravitation of the water occurs in consequence of the steam in the ascending water space being of less specific gravity than the water in the descending space, or, in other words, because the steam is bulk for bulk lighter than the water; a given bulk of water in the descending space is only capable of displacing an equal bulk of steam, or steam and water, from the ascending water spaces. If the bulk of water in the descending water space is not equal to the contents of the ascending water spaces, then steam must accumulate to a certain extent in those spaces. It should be borne in mind that in a properly constructed boiler the whole contents of the ascending water spaces, both steam and water, move upwards at the same time.

The plan adopted by Messrs. Smith and Rodger to alleviate the evil of priming in Mr. Napier's boilers, was simply that of increasing the area of the descending water-space, and this has had the desired effect, as far as they have been able to carry out the principle of circulation: owing to the peculiar construction of those boilers that principle cannot be carried out to its full extent; however, as far as that principle has been carried out in those boilers, satisfactory results have followed. In one case, that of the boiler of the steamer *Loch Lomond*, Mr. Rodger, of Messrs. Smith and Rodger, informed me that the priming of it had been diminished, and the quantity of steam produced by it increased in consequence of his having ordered some of the upright tubes to be removed; now this is a case in which the amount of steam produced by a boiler has been increased in consequence of the amount of the heating surface having been diminished; apparently a paradox, but yet quite consistent with reason. The area of the descending water-space in the boiler having been too small, three evils arose from it;—First,—steam accumulated in the tubes which are the ascending water-spaces, as there was not sufficient descending water to drive all the steam out of the tubes. Second,—the parts of the tubes that were in contact with the steam contained within them, was not available heating surface for producing steam. Third,—the accumulations of steam in the tubes burst forth suddenly from them at such times as the strokes of the engine made a difference in the pressure of the steam, and at each irregular burst of steam from the tubes the engine primed, because some of the water was thrown up with the steam. Now, the removal of some of the tubes had too good effects:—First, the remaining tubes had a better supply of water, because there were fewer of them, among which the water came down by the descending water-space had to be divided; therefore, the steam produced in the tubes was pushed out of them more regularly by the water entering at their lower extremities, and consequently the regular issuing of the steam from the tubes did not violently throw up the water so as to cause priming. Second,—the parts of the tubes which were formerly in contact with steam, being now supplied with water, those parts became available heating surface. From what I have written you will perceive that Mr. Napier's patent boilers are very different from the plan of tubular boiler that I recommended.

Second,—With reference to the conducting power of metal for boilers, you say, "If the conducting power of the metal was perfect, the heat would be conducted edgeways through the plate as fast as it was received, and the temperature would never rise to an injurious degree." In this you are perfectly right, but I do not see its applicability to the point under discussion. Every one knows that the conducting power of iron is so bad, that a smith can hold in his hand one end of a piece of iron of 18 inches in length, the other end of which is brought to a welding heat, but these circumstances do not apply to the case of boilers as at present constructed; in them the very greatest thickness of iron which intervenes between the fire and the water is at the landing of plates and rivet heads, say, inch and a half or two inches thick. Now it is quite impossible by any ordinary fire to injure that thickness of metal if the water is kept in perfect contact with it. What I assert is, that at that or any ordinary thickness of boiler-plate iron, the conducting power of the metal is quite sufficient to prevent its being destroyed, provided water be kept in close contact with it; and again, if iron of the ordinary thickness in a boiler is burned, that destruction of it ought not to be referred to the bad conducting power of the iron, but to the fact of the water not having been kept in close contact with it. The task to be accomplished is, to construct boilers so, that whilst converting water into steam, the arrangements of the boiler shall be such that the steam cannot linger about the heating surface, and prevent the perfect contact of the water.

Third,—You say "Our objection to Mr. Johnstone's boiler is not that he has a special provision for maintaining a current, but that his water-spaces are such that they must become choked up and his boiler be destroyed when subjected to the deranging influences which exist in practice," and again, "We are opposed to his tube vertical flues which, by retaining some steam in the landing of the plates and other irregularities of surface, prevent the access of water in those situations." And again, "A vacuum in the boilers would bring the heating surface of the flues into contact." In reply; First,—In the construction of my flues they are so arranged that there are no landings of plates: each side of a flue is composed of one plate throughout its length and depth, without any irregularity of surface; and for boilers of the very largest dimensions, it is easy to get plates of such sizes as to answer this very desirable end.

Second,—The narrow water spaces of my boilers are purposely constructed for resisting external as well as internal pressure. In consequence of this, the formation of a vacuum within the boiler would not injure the water spaces. Third,—The accidental stopping up of any of the water spaces from extraneous matter having got into the boiler is next to impossible. In two of those boilers which I have at present working, the orifice or inlet passage for the water at the bottom of the water spaces is two feet long, and a quarter of an inch wide. Now, one of those water spaces would not be seriously injured unless the greater part of that space of two feet in length were closed up at one instant—a circumstance which is not at all probable, as the portions of extraneous matter in a boiler are never of such large dimensions, unless from the grossest negligence. As to the formation of deposit, either in the form of scale or balls, you are now convinced that it never will accumulate in a boiler that is properly attended to. Fourth,—You object to the width of the water space. Now, I have no objection to their being made of one inch or six inches in width, only the extra width would add to the quantity of water contained in my boilers, and make them as heavy and large as tubular boilers, without any advantage arising therefrom. In actual practice I find a quarter of an inch is plenty of width for the water spaces between the flues, and half an inch round the furnaces. I have now in operation with those widths of water spaces a 14-horse power boiler on board the *Firefly* steam yacht; this boiler supplies steam to a high-pressure steam engine; the exhaust steam forms a blast in the funnel, the same as in a locomotive, and as the boiler is supplied with sea water, I think you will admit that, under these circumstances, the boiler is put to as severe a test as it is possible to expose it to. If I have not already encroached too much on your patience, I may on a future occasion give you some particulars of the working of this boiler. Jas. Johnstone.

*Greenock, June 15th.*

[We refrain from remarks on the above until Mr. Johnstone has ended his communication.]

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## Art. XI.—PAPERS FOR REFERENCE.

### SPECIFICATION OF A DOCK AT CHATHAM, BY THE LATE MR. RENNIE. 1816.

We do hereby offer to perform the excavation, masonry, brickwork, piling, planking, &c. &c. of a new river wall and dry docks at His Majestys Dock Yard at Chatham, and such other works as are connected therewith and described in the plan at the Navy Office, and specification hereunto annexed, and at the several rates and prices following:—

| No | | £. | s. | d. | |
|---|---|---|---|---|---|
| 1 | Supplying timber for the gage piles of a coffer dam . . . . . . . at | 0 | 3 | 4 | ℘ foot. |
| 2 | For sheeting piles and for wall pieces and braces | 0 | 3 | 4 | ditto. |
| 3 | Pointing and preparing the gage piles and fixing shoes and hoops . . . . | 0 | 2 | 0 | ℘ piece. |
| 4 | Furnishing pile-shoes, hoops, and nails for the work in general . . . . . | 1 | 8 | 0 | ℘ cwt. |
| 5 | Driving the gage piles for the depth they are to be under the surface of the solid ground . | 0 | 2 | 0 | ℘ lineal foot. |
| 6 | Driving sheeting piles for dam . . . | 0 | 1 | 9 | ditto. |
| 7 | Pointing and preparing the sheeting piles, and fixing shoes and hoops . . . . . | 0 | 1 | 0 | ℘ pile. |
| 8 | Furnishing the screw-bolts and plates for the dam and works in general . . . . | 1 | 10 | 0 | ℘ cwt. |
| 9 | Fixing the wale pieces, cross braces, and iron work . . . . . . . . | 0 | 0 | 10 | ℘ foot. |
| 10 | Caulking the dams per lineal foot the whole length . . . . . . . | 0 | 1 | 0 | ℘ lineal foot. |
| 11 | Finding clay, and depositing and puddling it between the rows of piles in the dam, and also taking it out; finding a place to deposit it upon and depositing the same . . . . | 0 | 3 | 0 | ℘ cubic yard. |
| 12 | Excavating earth from the dock and entrance, and depositing it upon the ground to be found by the Navy Board, and also to fetch as much back as may be wanted when the masonry and brickwork is done, and depositing behind the walls and puddling or pounding it thereon. | 0 | 2 | 6 | ditto. |
| 13 | Excavating earth for the foundation of the river wall, and taking it away as before stated | 0 | 2 | 3 | ditto. |
| 14 | Finding elm timber for bearing piles, do. beech for do., do. Norway timber for do. . . | 0 | 2 | 1 | ℘ cubic foot. |
| 15 | Pointing and preparing the said piles, and fixing hoops and shoes . . . . . . | 0 | 1 | 0 | ℘ pile. |
| 16 | Driving the piles for the depth they are to be driven . . . . . . . . | 0 | 1 | 10 | ℘ lineal foot. |
| 17 | Furnishing the timber for cills, and laying them on the pile heads . . . . . | 0 | 3 | 6 | ℘ cubic foot. |
| 18 | Furnishing 6 in. beech plank, and laying, spiking, and fitting it on the cills . . . . | 0 | 3 | 10 | ditto. |
| 19 | Furnishing oak timber for cills of dock gates . | 0 | 3 | 9 | ditto. |
| 20 | Furnishing 6 in. elm piles for cills not less than a foot broad . . . . . . | 0 | 2 | 6 | ditto. |
| 21 | Furnishing grooving and tongueing cills, and fixing hoops and shoes . . . . . . | 0 | 2 | 2 | ℘ pile. |
| 22 | Furnishing driving ditto . . . . | 0 | 1 | 9 | ℘ lineal foot. |
| 23 | Furnishing oak cills for sleepers under floor . | 0 | 5 | 6 | ℘ cubic foot. |
| | Furnishing oak plank for ditto . . . | 0 | 6 | 0 | ditto. |
| 24 | Furnishing 4 in. sheeting piles for coffer dams and river wall . . . . . . . | 0 | 1 | 3 | ℘ taper foot. |
| 25 | Preparing, shoeing, and hooping ditto . . | 0 | 1 | 0 | ℘ pile. |
| 26 | Driving ditto . . . . . . . | 0 | 1 | 6 | ℘ lineal foot. |
| 27 | Finding clay and filling dams with it and taking it away when done with . . . . | 0 | 3 | 3 | ℘ cubic yard. |
| 28 | Finding timber and shoeing dams, and also puddling in bolts and iron work . . . | 0 | 3 | 9 | ℘ cubic foot. |
| 29 | Pulling up the piles and removing each length of coffer dam, filling it with clay puddle, fixing shoes, &c. until the whole is complete . | 100 | 0 | 0 | ℘ 50ft. of dam |
| 30 | Furnishing cills for foundation of river wall and fixing them . . . . . . | 0 | 2 | 3 | ℘ foot. |
| 31 | Furnishing 6 in. beech sheeting piles for toe of river wall, at least one foot broad . . | 0 | 3 | 6 | ℘ cubic foot. |
| 32 | Preparing, hooping, and shoeing ditto . . | 0 | 1 | 0 | ℘ pile. |
| 33 | Driving the piles for the depth they are to be under the foundation, and spiking them to the cills . . . . . . . . . | 0 | 1 | 10 | ℘ lineal foot. |
| 34 | Furnishing 6 in. beech planks for the base of the river wall and spiking them down to the cills | 0 | 3 | 10 | ℘ cubic foot. |
| 35 | Brick-work for the front of river wall, ditto for backing the said wall and dock . . . | 14 | 5 | 0 | ℘ rod. |
| 37 | Stone-work for the dock and entrance . . | 0 | 6 | 0 | ℘ cubic foot. |
| 38 | Ditto for capping ditto and river wall . | 0 | 6 | 0 | ditto. |
| 39 | Ditto for river wall . . . . | 0 | 5 | 10 | ditto. |
| 40 | Finding gravel and puddling it with lime grout behind the walls . . . . . | | 2 | 1 | ℘ cubic yard. |

And we do hereby engage that all the said works shall be completed in all respects according to the said specification hereunto annexed with all possible dispatch, as neither men or materials shall be wanted, say 18 months. No tender will be received that is not made according to the prescribed form, nor will any tender be received for performing a part of the works only, but a price must be inserted against every article. Every tender must be accompanied by a letter addressed to the Navy Board, and signed by two responsible persons, engaging to become bound with the persons tendering, in the sum of £10,000, for the due performance of the contract, and reference must be given in the said tender, to some respectable persons who are well acquainted with the sufficiency of the parties offering to become bound. When the works are done, or materials delivered to the amount of £1,000, and a certificate thereof signed by the officer or officers appointed to superintend and inspect the work, shall be produced to the Commissioners of the Navy, a navy bill for £750, will be made out payable in ninety days from the date thereof with interest thereon, at the rate of 3*d.* per cent. per diem, and so on. A bill for £750, when works shall be performed or materials delivered to the amount of £1,000, and a certificate thereof as aforesaid shall be produced, until the whole of the works shall be finished, when a final bill will be made out, provided the contract shall have been in all things faithfully fulfilled, otherwise the money which may have been reserved as aforesaid is to be forfeited.

*Specification of a Dock capable of receiving a first rate Man-of-War, and also of a River Wall to be built at the Royal Dockyard at Chatham.* 1816.

The dock is intended to be placed on the ground which lies between the docks 2 and 3, where the store cabins now are, and having its entrance to the river Medway at the landing jetty, which is proposed to be removed, as also the projecting part of the dockyard where the jetty now is, as represented in the plan.

The floor of the dock is intended to be on one level; the cill of the entrance is to be four feet under the low water of a spring tide, which rises 18 feet 6 inches, and the coping of the dock is to be 5 feet 6 inches above the top of these tides, making the whole depth of the cill under the surface or coping of the dock 28 feet.

The length of the floor from the breast of the wall at the head of the dock to the inner pointing of the gates is, to be 225 feet, the width at the top is to be 90 feet, and the width of the entrance within the gates is to be 37 feet. The whole of the above work is to be formed and executed according to the following mode :—

First.—A coffer dam is to be made next to the river Medway, to keep out the water from the work while executing, the length of which will be about 160 feet, and its shape to be that of a segment of a circle. The above dam is to be composed of two rows of piles placed at the distance of 5 feet from each other; each row is to have gage and principal piles of not less than 12 inches square, and driven at the distance of 10 feet from each other; those of the outer and inner rows are to be placed opposite, so that they may be connected with screw-bolts, as aftewards described. The gage piles to be driven to the depth of 7 feet under the lower part of the foundation; *i. e.* the square part is to be driven to this depth: they are to be pointed, and to have worked iron shoes of the weight of about 18lbs. each; the heads of these piles are to be 2 feet above the highest spring tides, and to have a strong hoop on each, to prevent them from splitting in driving. Each of these rows of piles is to have two double sets of wale pieces, the outer pieces not less than 12 inches × 6 inches, the inner set 12 inches square each whole piece; the upper wale pieces are to be placed within one foot of the tops of the piles; the lower sets are to be placed as near. to low water as they can conveniently be done. They are to be let into the principal, or gage piles, so as to have a clear space of 6 inches and a half between to receive the sheet piling; they are to be bolted to the principal piles by screw-bolts 1¼ inches square, having large plates of iron under the heads and nuts. Between each of these gage piles sheeting piles are to be driven of about 12 inches broad, by at least 6 inches thick, and of the same length, and driven to the same depth as the gage piles. These sheeting piles, as well as the gage piles, are to be planed straight on the edges, and close-keyed with a key pile between each of the gage piles, so as to make the joints perfectly close. They are also to be shod with iron shoes of 14lb. weight each, and to have a hoop on their heads to prevent them splitting in driving; and after the whole is completed, they are to be caulked, so as to be impervious to water. These two rows of piles are to be kept together by large screw-bolts 1½ inches square, having a piece of wood under the head and nut of each bolt 2 feet long, and not less than 12 inches × 6 inches, to lap over the meetings of the wale pieces; each of these pieces of wood to have a wrought iron plate 12 inches long by 6 inches broad, and ⅝ inches thick, and they are to have diagonal braces at their heads; the spaces between the rows of piles are to be filled with good clay well puddled until it becomes solid. As it is probable that the earth of the dockyard next to the river Medway may be loose or made earth, it will in this case be found necessary to carry the coffer dam at its ends for some distance within the wharf.

The space on which the dock is to be placed is to be excavated to the proper depth, length, and width, to hold the whole of the brick-work, timber work, and masonry of the dock, as well as to allow a sufficient space round it for a good puddle of clay and gravel to make the the whole water tight, and a slope for the earth to stand while the work is in hand, and a steam engine, with suitable pumps, is to be erected for the purpose of extracting the water while the works are in hand. This engine, with its pumps, is to be provided and worked at the expense of the principal officers and commissioners of the Navy.

The foundation of the dock entrance is to stand upon piles, but whether the whole will require to be piled, or only a part, must be determined after the ground has been opened and its nature fully ascertained. The piles for such as may be used are to be of beech or elm, and of diameter not less than one foot; the lengths will of course depend on the nature of the ground into which they are to be driven, but they will be most likely from 14 to 15 feet. On the heads of these piles transverse cills or sleepers are to be laid from 12 to 14 in. square, and the spaces between to be filled with ragstone, well beat into the ground to the level of their tops, and grouted with sharp sand and gravel in the proportion of one part lime to five of sand and gravel. When this is done, longitudinal cills, of like dimensions, are to be laid and filled with ragstones to within 6 inches of their tops, and from thence to the level of these cills is to be done with two courses of brickwork, to be laid in the same kind of mortar as the work to be afterwards described; after which, the whole is to be covered with a course of beech plank 6 inches thick, on which the wall inverted and arch of the dock is to be laid.

At the entrance of the dock there are to be two transverse cills of fir at least 75 feet in length, and not less than 12 inches square; these cills are to be placed at the distance of 6 inches, and on a straight bed of brickwork: and between them is to be a course of 6-inch beech or elm sheeting piles, grooved and tongued, of the length of 15 feet, and driven close together. that they may be impervious to water; and the cills are to be bolted together through the pile heads with bolts 1¼ inches square, and at the distance of 18 inches to 2 feet; the piles are to have iron shoes and hoops on their heads, as before described.

When the floor is completed as described, the dock is to be built upon it of the form and dimensions as represented in the plans and sections. The side walls and inverted arch under the chamber of the dock are to be of brickwork, done with the best hard burned sound stocks, to be worked together in Roman cement or Puzzolana mortar, as is afterwards described. The inverted arch of brickwork is to extend as far as the floor of the dock, and from thence to the top of the dock it is to be done with inverted arches of Aberdeen or Cornish granite, the inside of which is to form altars, as represented in the section. The stairs and slips are in like manner to be excavated with this kind of stone.

The entrance is also to be faced with stone, and formed like an inverted arch, but the courses of the stone are for this length to be horizontal, as well as the recess and entrance wings; none of the courses of the stone are to be less than 15 inches thick, but the difference will vary according to their respective situations in the dock and entrance; each course, however, is to be done with the same thickness of stone throughout the whole length of the course. Those parts of the work where stones are to lie on horizontal beds, are to be done, header and stretcher alternately. The headers are not to be less than 2 feet 6 inches broad in the face by 5½ feet deep in the beds on the average, but no stone less than 4½ feet. The stretchers are not to be longer than 5 feet, nor less than 2 feet deep in the bed on the average, but no stone less than 3 feet. The stones of the inverted arch which are to form the altars of the dock to be of the dimensions and forms represented in the sections, none of which are to be shorter in the face than 4 feet; their depth of beds will vary from 4 to 6½ feet, and thickness according to the respective situations. The whole is to be capped with blocks of granite 18 inches thick by 5 feet broad, and in length not less than 4 feet, but the longer they are the better. The floor of the dock is to be formed as in the drawing, namely, longitudinal cills, 14 or 15 inches square, covered with transverse cills of similar size; the space between them filled with good sound brickwork, over which the floor planks of oak are to be laid, declining towards the altars, where a drain is to be formed to carry off the water; but it is to be understood that the principal officers and Commissioners of the Navy are to have it in their power to substitute a stone floor in the place of wood, should they judge it advisable; and in this case the inverted arch of stone will be continued under the whole opening of the dock. The main cill of the dock gates is to be of oak 18 inches square, and there are to be cills under the opening of the gates, as also pointed cills, and the whole to be covered with plank as in the drawing; a floor of timber is also to be placed under the entrance. There are to be two openings, one on each side of the entrance within the gates, and culverts or drains in the solid brickwork under the altars on each side, to meet at the inner extremity of the dock another drain, which is to convey the water from the docks into the steam-engine wall. These drains are to have sluices upon them of cast iron, working on brass faces, to shut out water from the engine-wall, or to admit it at pleasure, and these sluices are to be raised with suitable wheels and rackwork. There is to be a puddle of gravel laid round the whole of the dock and walls, at least 8 feet thick at the bottom, and diminishing to 3 feet thick at the top, which is to mixed with lime grout. The stones are all to be drove with a chisel for at least 4 inches in breadth round the beds and upper joints, and also the side joints, and the space between is to be fair punched or hammer dressed. The outside is to be droved througbout or dressed fair with a pick equal to droving, as is also the coping; the whole of the blocks are to be of full dimensions, and square, so that they may be close and solid throughout. The mortar is to be made with Marstham or Dorking lime of the best sort for setting in water, and it is all to be used as hot as possible, and ground into a powder before being mixed with the sand, but not slacked. The front mortar (except for the inverted arch of the entrance and front of the walls, which is to be of Roman cement or Puzzolana mortar) is to be mixed in the proportion of 3 parts of clear sharp river sand to one part of lime powder; the backing mortar is to have 4 parts of like sand to one part of lime powder; the lime is to be used as hot as possible, and no water is to be put to it until it is to be mixed up for use.

The work is to be done at least 18 inches deep from the face, with the mortar above described, and the rest with the hearting mortar. When Puzzolana is used it is to be mixed in the following proportions; namely, one part of ground Puzzolano, to one part of lime-powder, and two parts of clear sharp sand, the whole to be mixed with water, and ground in the mortar mill.

The foundation of the river wall is to be laid at the depth of 5 feet under the low water of spring tides, and carried up to the level of the dock walls; the base of this wall is to be $7\frac{1}{2}$ feet, and reduced to $6\frac{1}{2}$ feet by off sets at the height of 2 feet, at which thickness it is to be continued to the top, and there is to be counter forts behind the wall 15 feet asunder and 3 feet 9 inches square.

The foundation of the wall is to be cut to the form of its base, according to the radius with which its face is described, and a row of 6 inch beech sheeting piles are to be driven under its toe at right angles of the said base, and for at least 10 feet deep; these piles are to be shod with iron, and to have hoops on their heads to prevent them from splitting; when these are driven to their proper depth, a beech or fir cill of 12 or 13 inches deep, and about 6 inches thick, is to be laid on edge, and let about 3 inches into the sheeting piles, and another cill of like dimensions on the outside, but not let into them, and these two cills and sheeting piles are to be bolted together by $1\frac{1}{2}$ inch bolts, placed not farther asunder than 2 feet; a similar cill is to be laid at the back of the wall, and a short cill at the back of each counterfort; the cills are to be laid flat on the bottom, and no piles are proposed to be under them unless the foundation shall prove soft, in which case piles will be required, but the number and size will depend on the nature of the sub strata. The cills and sheeting piles in front, and also the back cills, are to be covered with 6 inch beech planks, let into the front cills, and on this the foundation of the wall is to be laid. The face of the wall is to be done either with granite or with sound made paviors, as the principal officer and Commissioners of the Navy may determine, and the back with hard, sound stocks; if of the former, the stone is to be in courses 12, 15, 18, and 21 inches thick; they are to be laid header and stretcher alternately, the headers not to be less than 2 feet long in the face, by an average of 4 feet deep in the bed, but no stone less than $3\frac{1}{2}$ feet, nor larger than 6 feet, by an average breadth of 3 feet, but no stone less than $2\frac{1}{2}$ feet; they are to be droved round the beds and edges with a chisel, and fire hammer dressed between; they are to be champhered in the upper and under joints, and smooth dressed on the face, and to be laid in Roman cement or Puzzolana mortar, as before described; and every stone to be of its full size throughout, and each course for its whole length is to be of one thickness. The front and backing mortar is to be of the same composition as has been already described, and the whole work is to be equally well executed as the docks.

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SPECIFICATION OF THE STEAM SHIP "CITY OF LONDON."

[We have much pleasure in laying before our readers the specification of the iron steam ship, *City of London,* constructed by Mr. Robert Napier, and which has proved herself to be one of the most efficient iron steam vessels yet afloat, at the same time that she is known to be one of the most handsome. We do not know that we could adduce any more eligible example of an iron steamer than the *City of London,* and the specification of such a vessel will be useful as a guide to future constructors.]

| | | | |
|---|---|---|---|
| *Dimensions.* | Length of Keel | 194 ft. | 0 in. |
| | Keel and Fore-rake | 216 | 0 |
| | Breadth of Beam | 31 | 0 |
| | Depth of Hold | 19 | 4 |
| | Height of Poop-Deck | 4 | 0 |
| | Projection before and abaft Paddle Boxes | 5 | 6 |

*Keel.*—Of best hammered iron 6 × 3 in., in not more than seven lengths welded together, or with scarphs 18 in. long, neatly planed and fitted so that the joints may be perfectly water tight, double rivetted, and countersunk, the holes in keel and plates to be bored out and rimmeled and the rivets to be turned to fit them.

*Stem.*—Of best hammered iron $3\frac{1}{2}$ in. thick by 6 in. broad at top and 9 in. at the bottom, kneed for about 4 ft. so as to form part of the keel, to be welded, scarphed, and rivetted similar to the keel, to be checked out by planing for securing the ends of the plates, and rounded over in front.

*Stern Post.*—Of best hammered iron 4 in. thick by 6 in. broad at top, and 9 in. at the bottom, to be kneed, scarphed, and rivetted, similar to the keel.

*Frames.*—Of angle iron 5 × 3 in. for 100 ft. amidships, composed of not more than 4 pieces, the butts in alternate frames to shift by at least 3 ft.; up to the 2 ft. waterline, to be $\frac{1}{2}$ in. thick, and placed throughout one foot asunder from centre to centre; all the frames before and abaft that, and in midships for 100 ft. up to the gunwale to be 4 × 3 × $\frac{1}{2}$ in. thick, to have a plate on transom frames 15 × 7-16 in. thick, kneed with triangular plates of the same thickness to stern-post and quarters. Butts to be joined with angle iron same size as frames, 3 ft. long, every alternate frame to run up for bulwarks and paddle-box stanchions.

*Plates.*—For 100 ft. amidships, viz. from the keel to the 2 ft. water-line 11-16 in. thick, from that up to the 6 ft. 9-16 in., from 6 to 15 ft. $\frac{1}{2}$ in. thick; all the plates before and abaft to the 2 ft. water-line $\frac{5}{8}$ in., from 2 to 6 ft. $\frac{1}{2}$ in., from 6 to 15 ft. 7-16 in., the remainder of plates to gunwale $\frac{3}{8}$ in. thick, except the plates to which the beams are attached, which are all to be made 1-16th in. thicker, from gunwale to quarter-deck rail $\frac{1}{4}$ in. thick, bulwarks and paddle-boxes 3-16th in. thick. Bulwarks to be lined all round inside with 1 in. yellow pine; the plating throughout to be lap-jointed on the longitudinal section, and jump-jointed on the vertical section, having flat bars of iron 9 in. broad of same thickness as the plates placed over the jumped joints, to be also double rivetted throughout, and it is meant that on the vertical joints two rows of rivets shall be on each side of the seam.

*Floors.*—Of plates 21 × $\frac{5}{8}$ in. thick, with angle iron 3 × 3 × $\frac{5}{8}$ in. rivetted on one side of top edge, and for 100 ft. amidships the angle iron to be run up to first stringer, before and abaft that to be run up only on each alternate frame, the whole of the floors, and angle iron on floors to be securely rivetted to the frames with $\frac{3}{4}$ in. rivets, every 6 inches. The floors aft to be carried up as crutches until they are two feet broad at top.

*Keelsons.*—To have five rows or courses of plates same depth and thickness as floor plates, running fore and aft in straight lines, the centre one from stem to stern-post, the other four as far fore and aft as the bottom of the vessel will admit, to act as keelsons fitted in between each floor and fastened to them by angle irons; those fore and afters to be kept up 3 in. from floor, except the centre one which must extend down to and support the keel, having holes cut through it for bilge water: to have angle irons 3 × 3 × $\frac{5}{8}$ in., placed back to back on each side of the top edge; viz. where the plates rise the 3 in. above the floorings, and securely rivetted to them, and to angle iron of floors, the whole forming five connected lines of fore and aft plates same depth as floorings, with two rows of angle iron back to back, firmly secured to each row of fore and aft plates.

*Stringers.*—To have main, quarter, and 'twixt deck stringers of angle iron. The main 'twixt deck and lower stringer to run right round the vessel; main and quarter deck stringer to be 4 × $3\frac{1}{2}$ × $\frac{1}{2}$ in. rivetted to shell and plates 24 in. broad by 7-16 in. thick for main, and 18 in. × $\frac{3}{8}$ in. for quarter-deck, rivetted to them and to each other, overlappin by 8 in., with 12 rivets for main and 8 rivets for quarter-deck of $\frac{3}{4}$ in. into each beam-end. 'Twixt deck stringer $4\frac{1}{2}$ × $4\frac{1}{2}$×$\frac{1}{2}$ in. rivetted to reversed angle irons on every frame, and to beams having two $\frac{3}{4}$ in. rivets in each, with a plate, where beams are attached, 10 in. broad × $\frac{3}{8}$ in. similarly rivetted; to have also a stringer 4 × 4 × $\frac{1}{2}$ in. running entirely round the vessel in a line with after-'twixt-decks.

*Paddle and Engine Beams.*—Paddle beams of iron 22 in. square framed with $3\frac{1}{2}$ in. angle iron and plated with $\frac{1}{2}$ in. plates, to be kneed fore and aft to side and wing with triangular plates $\frac{5}{8}$ in. thick, and 30 in. long in the arms, and to have two diagonal stays under each end 3 in. diameter, with suspension rods, standards and stays above decks. Two crank beams in engine-room to be 14 in. square, framed with 3 in. angle iron and plated with $\frac{3}{8}$ in. plates, and to have four fore and afters between crank and paddle beams opposite framing, 14 × $\frac{3}{8}$ in. thick with 3 in. angle iron rivetted on both sides at top, and circular moulded iron on lower edges.

*Beams.*—Main and 'twixt-deck beams of plate iron, 12 in. in centre, and tapering to 10 in. at ends, $\frac{3}{8}$ in. thick, with angle iron 3 ×$2\frac{1}{2}$ × 5-16 in. rivetted on each side of top of beams, and two bars of iron $2\frac{1}{2}$ in. broad by $\frac{1}{2}$ in. thick, and neatly bevelled off at corners, rivetted on each side of under edge. Quarter-deck beams 10 in. in the centre and tapering to 8 in. at the ends, 5-16 in. thick, with $2\frac{1}{2}$ in. angle iron on each side at top, or of beam iron in proportion to the others, rivetted to the frames, with three 7-8ths in. rivets in each end, and triangular plate knees 24 in. long in the arms, 7-16 in. thick for main and 'twixt decks, and 18 in. by $\frac{3}{8}$ in. for quarter-deck, the frames to have extra fastening to shell where beams are attached; in general, one beam on every second frame for all the decks, except where engines, boilers, hatches, &c., interfere; fore and afters for mast partners, &c. same strength as beams; carlins to be put in where necessary, and the beams at ends of carlins to be made proportionably stronger; to have an iron stanchion, 2 in. diameter in lower hold, $1\frac{3}{4}$ in. in upper hold, under centre of every second beam, connecting them to each other, and to the beams and floors in a secure manner, so as to act as ties as well as supports to the deck and bottom.

*Bulkheads.*—To have four water-tight iron bulkheads, placed in such positions as may be afterwards fixed upon, two of them to be $\frac{1}{4}$ in. thick, strengthened with 3 in. angle iron, the others to be 3-16 in. thick, and strengthened with angle iron, to have a strong arched plate bulkhead between engines and boilers, securely rivetted to side frames and beams.

*Wing Wales.*—Of iron, framed with angle iron, $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in., and $\frac{1}{2}$ in., and plated with plates 7-16 in. thick, to be the same depth as bulwarks and end of paddle beams, to be properly kneed and fastened on the strongest and most approved principle.

*Rudder.*—Of best hammered iron, stock 5 in. diameter down to where back starts off, below that 5 × 3 in. plates $\frac{5}{8}$ in. thick, secured with four iron bands to stern-post, deck, and counter; rudder case of iron 5-16 in. thick.

*Paddle-Wings.*—Of iron, longitudinal plates and carlins 13 × 7-16 in., with $3\frac{1}{2}$ in. angle iron, on both edges, rivetted to wing-wales and hull, and decked with malleable iron open frame work.

*Cutwater.*—Formed with hull, knees and rails of elm with trail-boards complete.

*Stanchions.*—Mock stanchions secured to the frames.

*Quarter and Stern Timbers.*—Of angle iron of equal strength with the other parts of the vessel. Stern to be square, finished in a neat and handsome manner with quarter galleries and mouldings, glazed with plate glass, &c.

*Knightheads.*—Of East India teak, 6 in. thick, to be $3\frac{1}{2}$ ft. broad on each side of stem, and run down into hull seven feet, properly fastened.

*Timberheads.*—Of East India teak, where required to be covered with cast iron.

*Waterways.*—Of Dantzic pine; main waterways, 12 in. by 7 in.; quarter deck waterways, 11 in. by 5.; to be bolted to outside plates every 20 in., and screwed down upon felt to stringer with $\frac{3}{4}$ in. screw bolts every 12 in.

*Deck Planks.*—To be sawn at least three months before being laid; main deck of Quebec yellow pine, 6 in. by 4 in.; quarter-deck of same, 5 × 3 in. thick, 5 in. broad at fore end, and tapered aft.; 'twixt deck, 6 × by $2\frac{1}{2}$ in. to be secured alternately from below with screw bolts, and bolts through and through, with their heads let in and dowelled above; main and fore cabin soles of $2\frac{1}{4}$ in., yellow pine grooved and feathered: all the decks to be properly and sufficiently caulked.

*Flooring and Ceiling of Holds.*—Flooring of elmwood 3 in. thick, ceiling of sheet iron 3-16ths in. thick, fastened with screws to plates rivetted to frames, or of red pine, $2\frac{1}{2}$ in. thick above 'twixt decks, alternately 6 in. plank, and 6 in. opening.

*Breast Hooks.*—To have at least four malleable iron breast hooks, consisting of triangular plates $\frac{3}{4}$ in. thick, rivetted to the stringers.

*Rails.*—Elm, 12 in. broad, by 4 in. thick; quarter-deck rails 8 in. in breadth by 3 in. thick, to be all covered round outside with copper; stanchions for quarter-deck mahogany, $5\frac{1}{2}$ in. by $4\frac{1}{2}$ in. thick at the gunwale, and $3\frac{3}{4}$ in. at the rail. Top gallant forecastle rails and stanchions of iron.

*Paul-bitts.*—African or English oak, sided 16 in., and moulded 17 in., to go down to the keelson.—Windlass, African or English oak, 20 in. diameter, and to have a patent purchase. Windlass bitts ditto, 7 in. thick by 22 in. broad; the windlass to be fitted with patent cast iron wheel and pauls, with strong wheel and pinion purchase, to have cross-rail, bell, and neat cast iron belfry; windlass spindles $3\frac{3}{4}$ in. diameter. The windlass to be cased for chain cables, and complete with chain boxes, hawse pipes, &c. The oak plank for rangeheads to be one inch thicker than deck.

*Catheads.*—Of British or African Oak, 12 in. square.

*Hatches* and companions, skylights, scuttles, &c. in such number, dimensions and style as may be thought necessary by the Directors; in particular to have one handsome skylight for main saloon, and one for each sleeping saloon, with brass gratings; style to correspond with finish of cabins; stained glass in skylights, with appropriate devices; patent deck lights where required; patent side lights fitted in brass frames, &c.

*Pumps.*—Two aft and one forward, to be provided of iron, complete, with brass chambers of necessary size, having tail pipes connecting them with each separate water-tight compartment.

*Anchors, Chain Cables and Warps.*—To be supplied in number, weight and size, necessary and according to Lloyd's specifications, with all appendages; also two mooring chains, 20 fathoms each.

*Poop Deck Furniture, and Finishing.*—The poop deck bulwarks to be neatly grated round with rope net-work, to have a handsome mahogany steering-wheel neatly mounted and inlaid with brass, of sufficient size; barrel with spindle and standards, complete; hide ropes and wooden blocks, iron strapped, with brass sheaves; all the parts requiring to be covered, to boxed in with timber, checkered work, binnacles of brass, and bell complete, with the compasses faithfully regulated to counteract the attraction; eight quarter-deck chairs to correspond with quarter-deck fittings; two gangway ladders, one on each side, capable of being let down, fitted with strong iron hinges, and iron crane, complete, with man-ropes, and other necessaries; awning standards of iron, with awning, complete; one dozen water-buckets, 2 meat safes and two handsome chests, water cisterns lined with lead, to be placed round companion, of sufficient size, with pump and cocks; two quarter and one stern boat with oars and davits complete; bridge boards between and along paddle boxes, fitted as usual with iron railing and ladders; a speaking trumpet, communicating therefrom with engine-room.

*Cranes and Winches.*—Two cranes complete, one commanding the fore, the other the after hold, sufficient to lift 2 tons each; one powerful double winch abaft the foremast, with a full assortment of hooks and slings, &c. for working the cargo.

*Masts and Spars.*—The vessel to be schooner-rigged, with three masts, and the builders to furnish all masts and spars, bowsprits, jib-booms, &c. of best Quebec red pine. Fore and main masts 68 or 70 feet high, by 19 inches; mizen mast, 50 feet, stepped in a strong trussed beam of the poop; also all iron cross-trees, crances, and other iron work attached to them.

*Rigging.*—The contractors to furnish and fit up all standing and running rigging complete, to be made from the very best Riga hemp, with all rope and chain stays, blocks, &c. The size of the rigging to be as under:—

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|---|---|
| Fore stay to be ... ... ... ... | $8\frac{1}{2}$ inch rope. |
| Middle stay and fore rigging ... ... | $6\frac{1}{2}$ " |
| Main stay and main rigging ... ... | $5\frac{1}{2}$ " |
| Mizen stay and mizen rigging ... ... | $4\frac{1}{2}$ " |

and all other running rigging and stays to be in proportion to the above, and all to be of patent manufacture; also a full and complete suit of sails, tarpaulings, and boat coverings, fitting for a vessel of that size and dimensions specified in the contract, and to be all of the very best No. 2 to No. 5 Navy canvass.

*Tanks.*—One iron tank in after peak, and others, large enough to contain 20 tons of water, and fixed in the most suitable parts of the vessel, with pumps and pipes complete.

*Cannons.*—To be supplied with two brass cannons.

*Chocks.*—Of cast iron, 2 forward and 2 aft, on top of rail.

*Fenders.*—Four paddle-box fenders of British oak, with chains; 6 cork fenders.

*Head.*—To have a full gilt figure-head and quarter galleries, with stern carving, 7 stern windows, and 8 or 9 windows in the sides of cabin, all filled with plate glass, with strong hinged ports, and proper brass fastenings for dead lights; patent ventilators in the cabin, and all other recent improvements introduced.

*Cabins, &c.*—The vessel to be fitted up with cabins, and berthed for 70 cabin and 30 steerage passengers, having a space below the main cabin aft fitted up as steward's store-room; to have a steerage or second cabin forward; top-gallant forecastle and deck-houses fore and aft the paddle-boxes, fitted up as state rooms for the captain, mates, engineers, and firemen; also berths and lockers in the forecastle or forepeak, for the sailors. A plan of the main and fore cabins and general arrangement of deck houses to be submitted to the directors of the company for approval prior to being proceeded with. The contractors to furnish all wash-hand stands, basins, cisterns, pipes and cocks, water-closets, and other cisterns, grates and stoves, mirrors in saloon and dressing-rooms, a time-piece, sofas, chairs, tables, and camp-stools, of sufficient size, number, and quality, equal in every respect to the *City of Aberdeen*, or any other steamer of a similar class that may be pointed out.

It is to be understood, in conclusion, that the ship throughout is to be built and fastened on the most approved principles, that is, as herein specified, and that the builders or contractors are to furnish at their own expense, and to the entire satisfaction of the Directors of the Aberdeen Steam Navigation Company, or their inspectors, in respect to design and execution, whether previously herein mentioned or not, all materials, carpenter, joiner, blockmaker, sailmaker, blacksmith, plumber, glazier, painter, upholstery, and all other work connected with the entire completion of the hull, cabins, berths, decks, cook, and other deck-houses, and also all mate's, boatswain, steward's, cook's, and other stores in full, equal in every respect to those on board the *City of Aberdeen*, or any steamer of a similar class. In short, the vessel, machinery, and boilers to be built found, and fitted out as an iron steam ship, complete and ready for sea in every respect by the contractors by the 25th day of April, 1844, (the machinery and boilers to be furnished in terms of specification No. 2, herewith sent), with the exception of silver plate, crockery ware, table-cloths, bedding, and other napery.

*Quality of materials.*—The whole of the plates, angle-iron, &c. used in the construction of the vessel to be of the best S crown, Colebrookdale, Oak Farm, or Messrs. Thornycroft's iron, the rivets of the best Yorkshire iron; the wood used to be all well seasoned, and of best quality, free from sapwood, shakes, or other imperfections; in short, all materials used in the construction of the shell, frames, floors, ceilings, &c. to be of the very best description, free from all blemish or defect.

*Power to alter.*—It will be understood that the Company shall have power to make, during the progress of the work, any alteration or addition they may think necessary or beneficial; but no alteration shall be allowed to be made unless sanctioned by the Company's inspector, and the conditions of said alteration signed by the Company's chairman for the time being. In the event of any such alteration being made, the extra charge or deduction shall be agreed on before the change is entered into.

The vessel when launched must be perfectly tight, all caulked outside and inside where practicable: the contractors to uphold her from all defects in materials or workmanship for the period of twelve calendar months from the time of the vessel being handed over.

*Not to accept lowest offer.*—The Directors of the Company not to be bound to accept lowest offer unless considered otherwise satisfactory.

*To deliver tenders.*—Parties wishing to contract must have their tenders delivered at the Company's office, Aberdeen, on or before the 24th day of May next, and the specifications and tracing signed and returned with said offer as relative thereto.

*To find surety.*—The contractors to find security for the implement of their offer to the satisfaction of the Directors of the Company, and to enter into a formal and binding deed of contract when required.

*Penalty for non-performance.*—It is hereby distinctly declared, that in the event of the contractor or contractors failing to perform the engagements, or not having fulfilled their contract within the above stipulated time, the contract price is to suffer a reduction at the rate of £20 sterling per diem for every day that may so elapse after the expiry of the above mentioned time, until all the foresaid engagements shall have been respectively fulfilled, and the vessel handed over complete as the property of the Company.

*Aberdeen, May 3rd,* 1843.

FINE ARTS.

*Medical Criticisms upon Paintings.*—The *Gazette des Hospitaux* contains some amusing criticisms on the works of French artists considered in a medical or scientific point of view, in which any errors in the anatomy or pathology of the objects represented are detected and exposed with much acuteness. Such criticisms are likely to prove of use; but yet a medical taste can hardly be accepted as the standard by which all other tastes must be tried, and the hieroglyphics which bespeak profound anatomical skill, and which earn a medical approbation, will be devoid of meaning to ordinary spectators, or may excite feelings of aversion. Up to a certain point anatomical knowledge is useful to the artist; but though he may astonish, he will eventually weary and disgust if he displays his anatomical knowledge with too great ostentation.

*Prussian Society of Arts*—At a late meeting of the Prussian Society of Arts, the whole council, with De Olbers at their head, resigned their offices. Symptoms of dissatisfaction, it is said, had for some time past been manifested to their rule, on the ground that the society did not encourage the right description of art or artists, and they preferred the resignation of their officers to the endurance of such imputations. In spite, however, of this disturbing force, the French antiquary M. Raoul Rochette, who has lately produced a work on the wall pictures of Pompeii, was hospitably entertained, and the breach between the council and the members was not suffered to mar the harmony of the occasion.

*The Effect of Free Trade upon the Fine Arts.*—Protection, as it is grotesquely called, blasts the promise of every art that is encumbered by its aid. At a late meeting, held at the Royal College of Chemistry, a new institution of great prospective utility, Lord Clarendon gave an illustration of the truth of this remark by the following anecdote:—When he was a member of the mixed commission, which, some years ago met at Paris, with the object of placing the commercial relations between France and England upon a more satisfactory footing, and when one of their first inquiries had been made respecting the cause of the undoubted superiority of the French manufactures, particularly those of Lyons, over our own in all matters involving taste, composition, design, and colour, they found that at Lyons there were regular schools where young men were taught anatomy, in order that they should obtain true ideas of proportion; drawing in every branch that would lead to correctness of form and beauty of design; and chemistry, that they might understand the art of dyeing, and the durability and combination of colours. They found, moreover, that when the education of these young men was completed, their services were eagerly sought after by the manufacturers, and that in the direction of great establishments they at once obtained honourable and lucrative employment. The Commission then naturally inquired what means in this respect were adopted at Coventry, and they were told that there was an old man who, when sober, occasionally furnished a pattern, but that nearly all the figured designs were copied from the French! Competition will speedily put an end to these evils, and by no other instrumentality can they be cured.

*Works of Art from Nineveh.*—Some very important discoveries of ancient works of art on the site of ancient Nineveh have lately been discovered by Mr. Layard, and the influence of Sir Stratford Canning has been exerted successfully with the Porte in obtaining leave for their transmission to this country. Of these interesting remains a correspondent of the *Times* gives the following account:—"The discoveries of M. Botta, at Horsabad, are well known to the learned world. Those in which Mr. Layard is now engaged at Nimroud promise to be much more interesting and extensive. The mound is eight or ten times larger than that which was excavated by the French. It contains the remains of a palace, a part of which, like that at Horsabad, appears to have been burnt. There is a vast series of chambers, all built with marble, and covered with sculptures and inscriptions. The inscriptions are in the cuneiform character, of the class usually termed Babylonian. It is possible that this edifice was built at an epoch prior to the overthrow of the Assyrian empire by the Medes and Babylonians under Cyaxeres, but whether under the first or second Assyrian dynasty is doubtful. Many of the sculptures discovered by Mr. Layard are, even in the smallest details, as sharp and fresh as though they had been chiselled yesterday. Amongst them is a pair of winged lions with human heads, which are about twelve feet high. They form the entrance to a temple. The execution of these two figures is admirable, and gives the highest idea of the knowledge and civilization of the Assyrians. There are many monsters of this kind, lions and bulls. The other reliefs consist of various divinities; some with eagles' heads; others entirely human, but winged; with battle-pieces and sieges, as at Horsabad."

*Ornamental Floors.*—At a late meeting of the Decorative Art Society, a paper "On Ornamental Floors" was read by Mr. Laugher, principally with a regard to the use of parquetry (or inlaid wood) in our principal apartments. Several observations, however, were made respecting the pavements and floors of antiquity, of which several familiar imitations were referred to in the painted floor cloths of the present day. It was observed, that boarded floors, usually of oak, were considered a very distinctive appurtenance to the English mansion in the 17th century, and that they received increased attention to ornamental effect in the early part of the 18th century, at which period the parquet floors had obtained considerable favour, and were constructed at great cost. Carpets of home manufacture then began to enter into competition with them, and the use of foreign deals which from their shrinking, rendered carpeting more essential to comfort, tended to the disuse of this superior kind of flooring. It was remarked, that at present, there was a revival in the feeling towards parquetry, and some explanations were given of several applications of steam and machinery by Messrs. Steinitz and Co. for accelerating not only the production of the geometric forms of the competent parts, but the ulterior processes of framing and construction, whereby considerable economy in time, labour, and cost resulted. Several observations were made upon the relative cost of parquetry, and it was said, that its price laid down marginally in dining-rooms, does not now exceed four times that of its imitation on painted cloths, and that for drawing-rooms, it is not more expensive than the richer kinds of carpet.

*Summary.*—The statues of Laplace and Malherbe, by Barre and Dantan, are to be inaugurated, at Caen, in the course of November next.—The fine sarcophagus executed by Professor Rauch for King Frederick William III., at Potsdam, where H. M. lies close to his consort, is completed, and will shortly be accessible to public inspection.—At Leipsic, a monument is about to be erected to the philosopher Leibnitz.—At Brussels, the Committee of the Royal Museum of Painting and Sculpture is busy in arranging its treasures of Art in the new galleries.—In Paris, the Exhibition of the Academy of Industry is now open, at the Orangery of the Tuileries.—The French Minister of Public Instruction has sent M. Alexandre, one of the Inspectors-General of the University, to Greece, to examine into the best means for facilitating the study of Modern Greek in the Royal colleges of France. It is intended, too, to found an establishment at Athens; to which a certain number of pupils of the normal schools are to be sent, with a view to the same acquisition.—At Metz, the Archæological Congress met on the 1st June, when M. de Caumont was elected President, and the Abbé Lepetit, Secretary-General.—The Francesca Catharina, with a cargo of marble for the tomb of the Emperor Napoleon, arrived on Sunday at Havre, on its way to Rouen. This vessel, after having been obliged to put into Gibraltar and Lisbon, was caught in the Bay of Biscay in a violent gale of wind, which placed it in great danger, and the crew were forced to throw overboard ten tons of its cargo.—The new fortifications at Gravesend on the burial-ground of the chantry, erected by Aymer de Valence, are rapidly proceeding. The original chapel, though cased over with modern brick work, is still standing. It is now converted into the military hospital. In the recent alteration necessary to such conversion, partitions, &c., were removed, which then developed its original shape: it was 59 feet long and 17 feet 7 inches in breadth, within the walls, and was covered with a cove roof, probably originally lined with boards. The height of the edifice from the floor to the highest point of the cove was about 16 feet.—The Temple of Dendera has been completely cleared of all the rubbish with which it was encumbered, and is now to be seen as one of the most perfect of the Egyptian temples.—The galvano-plastic process has been applied on a large scale at the establishment of the Baron de Hackewitz, at Berlin—a colossal plaster *fac-simile* of Ludovisi's Head of Juno, and a bust in plaster, modelled for the head by the sculptor Rauch, having been both covered with bronze. The frontal region of the head of the statue is upwards of six feet in diameter, and nearly eighteen in circumference. The operation was performed in presence of the King. The King gave orders for preparing, for the same process, a plaster cast of Thorwaldsen's statue of Christ, and a model in wood of the gates destined for the church of the royal palace of Wittemberg.—On removing the old oak stalls from the chancel of St. Mary's Church, Nottingham, preparatory to the repairing of the roof, a sculptured tablet of marble was discovered, buried with its face downward, which probably has been lying there since the period of the Reformation. It is a spirited and well-executed *bas-relief;* consisting of eight figures, which represent the Pope seated on a canopied and elevated throne, inaugurating a bishop—probably the bishop of the diocese. Beside the Pope are two cardinals, wearing their hats. The bishop is attended by his apparitor, bearing the crosier; and three other attendant figures complete the group. The tablet is about two feet in height and one in width; and has been curiously painted and illuminated. There were also discovered some Hanse Town tokens and Peters pence.—Mr. Steell's colossal statue in white marble of Sir Walter Scott, is now in such a state offorwardness that it is fully expected to be ready for erection on its pedestal, in the monument in Princes-street, on the 15th of August—the anniversary of the poet's birth day.—The picturesque little chapel opposite the toll-bar at Kingsland is now being unroofed, preparatory to its destruction, by the sanction of the governors of Bartholomew's Hospital.—An exhibition of tapestries and porcelain—the products of the Royal Manu factories of Gobelins, Beauvais, and Sevrés, is now open at the Louvre.—The 20th Exhibition of the Royal Hibernian Academy is now open in Dublin; and many of the exhibitors at our own Royal Academy figure on its walls.—Mr. Lough's marble statue of Southey, for his sepulchral monument in Crossthwaite Church, Keswick, is now completed, and has undergone much improvement since we saw the model in the Royal Academy. The likeness of the man is very striking; and the idea of the writer is well and characteristically conveyed. The figure is a fine bold piece of monumental sculpture. The monument is intended to be shortly erected; but the committee, we understand, are in want of funds.—The French papers publish a long report presented to the Minister of the Interior by M. Mérimée, Inspector of Historical Monuments It appears from this document that, notwithstanding the insufficiency of its resources, the Committee of of Historical Monuments in France, has not only not suspended any of the grand restorations that were undertaken by it, but has even been able to purchase some monuments which would otherwise have been lost. The most important is the Church of St. Julien, at Tours, an admirable specimen of the architecture of the thirteenth century.—The *Great Western Advertiser* mentions that the inhabitants of Glastonbury are about to rebuild their High Cross, in harmony with the rich old architectural features of that ancient town. The Cross will be about fifty feet high, composed of Bath stone, and highly ornamented throughout.—The students of the University at Berlin, and Professors and pupils of the Royal School of the Fine Arts, have been serenading the painter Cornelius, on the occasion of his return from Rome with his frescos, for the Campo Santo. National airs were performed in his honour by a band of 2,000 voices and three hundred and twenty wind instruments; and fifty thousand persons added, by their presence, to the homage of the scene.—The King of Holland has commanded a public exhibition of the Fine Arts at Amsterdam, to commence on the 7th of September and to last a month. Foreign artists are admitted among the exhibitors.—A discovery has been made at Arnac la Poste, in the Haute Vienne, in the old and curious crenelled church of the Templars, of some mural paintings which are considered to be of great historical value. Their date is of the 13th century.

CONSTRUCTION.

*The Iron Trade.*—The price of iron shews no symptoms of a decline, notwithstanding the impression prevailing at the beginning of the quarter that the existing prices could not be sustained. The Birmingham correspondent of the *Morning Herald* says :—

"If the American tariff, which our last advices from that country left lying on the table of the Senate, had not been interrupted in its progress by the Mexican war, there can be no doubt we should have every reason to look forward to a great advance in the price of iron. At present the duty on sheet iron imported into America out of this country is 56 dollars. The proposed new tariff would reduce it 14½ dollars, which, at the present cost of iron in this country, and freight, &c., would enable the American manufacturers to have good Staffordshire iron for about £15 a ton iu place of some £25, which it now costs in their own country. In the absence, however, of this great impetus, and knowing the state of our own market, I have no difficulty in saying there cannot be any further advance of prices."

At Glasgow the prices of pig-iron on the 6th of June, were 69s. for No. 1, and 65s. 6d. for No. 3, per ton, net cash. Sales to a moderate extent were effected at 69s. 67s. 6d. and 68s. 6d. for No 1 ; 65s., 66s., and 64s. for No. 3, net cash, and at 70s. by bills at three months—dealers not at all anxious to operate—market closed dull—but no decided decline to report. At Glasgow on the 13th of June, the transactions were 65s. to 66s. for No. 3; 67s. 6d. to 68d. 6d. for mixed numbers, and 70s. to 72s. 6d. for all No. 1. Cash f.o.b.—Most of the iron works, says the *Birmingham Advertiser*, in the manufacturing districts have been standing lately, the heat being so intense that the puddlers, in particular, cannot work. Several instances have occurred of men been carried out of the works, having fainted from exessive heat and exhaustion. At Glasgow on the 20th June, the demand improved, and several transactions took place at about the previous week's quotations. 65s. for No. 3, 67s. 6d. to 68s. 6d. for mixed Nos., and 70s. to 72s. 6d. for all No. 1. At the next quarterly Birmingham meeting, to be held in July, a demand of £1 a ton advance will be made. At Glasgow on the 23rd June, the market was quiet but firm, without alteration in prices.

*Engineering Innovations at Rome.*—A society of private individuals has presented to the Papal Government a plan, by which they undertake to render the Tiber navigable to large vessels as far as Ponte Felice. The proposal further contemplates the construction of a port at Fiumicino; and the establishment of a service of steam-boats, on the one side to Leghorn, and on the other to Naples, without touching at Civita Vecchia. The Pope it is said, has consented to let a company light the city with gas. The death of the reigning Pope which has just been announced may probably facilitate other innovations, and railways may perhaps be eventually tolerated.

*Superior Whitewash.* The *New York Sun* gives the following recipe for compounding a whitewash which it insinuates is superior to any other: Take half a bushel of nice unslacked lime ; slack it with boiling water, covering it during the process to keep in the steam. Strain the liquor through a fine sieve or strainer, and add to it a peck of clean salt, previously dissolved in warm water ; three pounds of ground rice, ground to a thin paste, and stirred and boiled hot; half a pound of powdered Spanish whitening, and a pound of clean glue, which has been previously dissolved by first soaking it well, and then hanging it over a slow fire, in a small kettle, within a large one filled with water. Add five gallons of hot water to the whole mixture; stir it well, and let it stand a few days covered from dirt. It should be put on quite hot; for this purpose it can be kept in a kettle on a portable furnace. It is said, that about one pint of this mixture will cover a square yard upon the outside of a house, if properly applied. Brushes, more or less small, may be used, according to the neatness of the job required. It retains its brilliancy for many years. There is nothing of the kind that will compare with it, either for inside or outside walls.

*Method of extirpating Lichens on Stone.*—For extirpating lichens, which so often prove injurious to stone buildings, a correspondent of the *Builder* recommends the employment of a solution of white arsenic in soft water. This being destructive to vegetable life, will not only kill any lichen already formed, but prevent its reproduction. It should be a transparent solution, not a *mechanical* mixture ; and as arsenic is very difficult of solution, a few pounds would make many gallons. The application of the liquid should be made by floating it over the faces of the stones before they are laid.

*Stability of Arches.*—A paper on the Stability of Arches, with Practical Methods for determining the proper Forms of their Sections, was lately read at the Institution of Civil Engineers by Mr. G. Snell. This paper consisted of four sections, with an appendix. The first section treated of the general conditions of stability in arches. The second discussed the conditions of stability of an arch composed of materials of infinite strength, to resist compression,—the arch being similar, and similarly loaded on either side the crown, and one of the points of rupture, therefore being assumed to be at the crown. The third section showed how the results of the investigations in the second section might be applied to actual practice, —or to the case of an arch of limited strength to resist compression, which was actually of yielding material, and which greatly affected the results of the problems in the former section, based on the hypothetical condition of infinite strength of material. This section showed how the form of section of an arch might be designed according to the strength of the material of which the arch was to be composed; but in this section, as in the second, this arch was supposed to be similar, and similarly loaded on either side the crown, and one point of rupture was assumed to be at the crown. The fourth section investigated the conditions of stability of an arch either similar or not similar, or similarly or not similarly loaded on either side of the crown of the arch; and the various points of failure were determined without the assumption of one of them. By means of this problem the proper form of section might be designed for an arch to be subjected to any number of pressures acting in any position and direction. Thus the effect of men walking over a vaulted ceiling or any other pressure in vertical directions, or the effect of the thrust of other arches, or of pressure in oblique directions, might be counteracted by the particular form of section arrived at by the application of the method described in this section.

*Summary.*—A Government bill has been brought into the House of Commons to enable the Commissioners of Woods and Forests to construct a new street from Spitalfields to Shoreditch, and for that purpose to raise a sum of £120,000 on the "Metropolis Improvement Fund."—It is proposed to erect new baths at Rotherham ; the sum of £500 has been voted for the purchase of a site in Westgate.—The new pier at Beaumaris is now open for the accommodation of the public. There is a convenient means for landing at all times of tide.—The Government, it is said, intend to erect the military station at Birmingham into a grand central depôt, to which most of the troops at Weedon will be removed.—The three public parks at Manchester are to be called Queen's Park, Peel's Park, and Philip's Park. —Within the last eighteen months the windows of the ancient flint-built church of St. Peter and St. Paul, near Sittingbourne, have been enriched with painted glass, at the expense of the incumbent, who is also himself the author of the designs.—The Cirencester agricultural college is now opened for the reception of students, of whom, when the additional wing now erecting is completed, it will accommodate 200. It is in the Elizabethan style : principal front to the south, with a façade of 190 feet by 50 feet in height, the centre relieved by a tower surmounted at the north-west angle by an octangular turret, the whole rising 93 feet from the lawn.—£10,000, it is said, has been contributed, one-half towards the erection of a college at Hong Kong, and the other half towards the endowment of a bishopric there.—The bill to enable boroughs and parishes to establish public baths and washhouses and open bathing places has been brought into Parliament by Sir G. Grey, and was ordered to be printed, and to be read a second time on Wednesday, July 1. The measure is one which meets with such general approbation that its progress through Parliament need not be impeded by any lengthened discussions —Preparations are making for the erection of the new college in Galway, on the site selected, and approved by the Board of Works. The design is described as being that of a splendid edifice—of the architectural style of Henry the Eighth's time—well adapted to the accidental resources of the locality, which abounds in limestone of the very best quality.—The Manchester baths and washhouses, in Millerstreet, are to be fitted up with a supply of eighteen baths, and twenty-six troughs for linen-washing; the Manchester and Salford water-works to supply the water.—The Trinity Board, on its late visit to the islands of Scilly, determined on erecting a Lighthouse upon the Island of Rose Vear ; after completing which, the present Lighthouse on St. Agnes will be raised 30 feet, in order that it may be distinctly seen to the eastward of the Island. —The foundation stone of the addition to Tintern Parva Church has been laid during the month. A portion of the old walls is to be rebuilt, and the church repewed when renovated and enlarged.—The Edinburgh Water Company, it is said, charges only 4s. per annum for water supplied to cottages let for less than £5 per annum, and in some cases only 3s.—From the report of the Building Committee of the Free Church of Scotland, lately read at their general assembly at Edinburgh, it appears that last year the number of churches erected amounted to 500, while this year the number was 621,—The amount of the fund collected for the Birmingham baths is at present about £6,000. Birmingham is a sleepy place for every movement except politics.—The foundation stone of the new church in the Victoria-road, Seacombe, has lately been laid. It is to be capable of accommodating 800 persons, and the cost is estimated at £2000. —The fouudation stone of the tower of the northern transept of Leamington parish church has been laid by the Rev. Vaughan Thomas; it is to be about one hundred and twenty feet in height, the transept itself being carried up to the same height as the present nave, with a large rose window about thirty feet in diameter ; the whole of the buildings to be in the early decorated style.—A new church is in the course of erection at Sutton Waldron, near Shaftesbury, Dorsetshire, at the expense of the incumbent, the Rev. A. Huxtable. It is in the decorated style, consisting of nave, chancel, south aisle, western tower and spire, and south porch.—The sum of 3800*l.* has been collected for the erection of the new Chapel of Ease at Cirencester. It is to consist of a north aisle, with a porch, a nave, and chancel, to which a tower and spire may be added as the funds permit.—The alterations of Durham Cathedral, with the view of restoring the interior to something like its original state, have been for some time in progress, The chapter-room is being restored, but the room has been curtailed in its dimensions to add to the size of the deanery gardens.—The second reading of the Places of Worship (Scotland) Bill, to compel the landed proprietors to yield sites for buildings in connection with the Free Church, was moved by Mr. Fox Maule in the Commons on the 11th June, but opposed by the Government ; Sir James Graham moving that it should be read that day six months.— The foundation stone of the new steam establishment at Keyham, Devonport, will be laid in August by the present First Lord of the Admiralty, if then in office. The contractors are Messrs. Baker and Son.—The select committee on the Edinburgh water-works have reported that the introduction of the bills both of the Edinburgh and of the Leith Water Company, should be suspended till a bill for the supply of water to Edinburgh and Leith, under a public trust, be introduced and passed, if possible, during the present session.—The line of electric telegraph between the metropolis and Leeds will be completed in the course of the summer, when seven minutes will suffice to convey intelligence between the two. Even at the present the communication reaches to the Midland station at Normanton, and the late division in the House of Lords was announced at Leeds about nine in the morning.—A glazier at Rotherham has a sheet of rough cast plate-glass 8 ft. 9 in. long, by 7 ft 3 in. wide, intended for the roof of a greenhouse.— Muspratt's great brick chimney, at Liverpool, lately saved its proprietors the trouble and expense of taking it down, as was intended, by toppling to the ground within the small yard in which it stood. It is thought that the chemical vapours constantly passing through it had injured the materials or destroyed their cement. A new chimney stalk is to be crected on its site. It ought we think to be lined with tile or glass piping so as to prevent any action upon the lime by which the bricks are cemented together.— Mr. Lardner, cotton-spinner, Preston, has recently erected a bath-room for his working people, including warm and vapour baths and shower bath.

RAILWAYS.

*Resolutions on the Gauges passed as amended in the Commons.*—1. That no line shall hereafter be formed on any other than the 4 ft. 8½ in. gauge, excepting lines to the south of the existing line from London to Bristol, and excepting small branches of a few miles in length in immediate connexion with the Great Western and South Wales; but that no such line as above excepted shall be sanctioned by Parliament, unless a special Report shall have been made by the committee on the bill, setting forth the reasons which have led the committee to advise that such line should be formed on any other than the 4 ft. 8½ in. gauge.

2. That it is the opinion of the House that provision should be made by law to prevent the directors of railway companies from altering the gauge.

3. That in order to complete the general chain of narrow gauge communication from the north of England to the southern coast, and to the port of Bristol, any suitable measures should be promoted to form a narrow gauge link from Gloucester to Bristol, and also from Oxford to Basingstoke, or by any shorter route connecting the proposed Rugby and Oxford line with the South-Western Railway, without prejudice however to the formation of any other line, also connecting, upon an uniform gauge and by a direct route, the north of England with the southern coast.

4. That it is the opinion of this House, that it is expedient that the South Wales line, and its branches to Monmouth and Hereford, should be formed on the broad gauge.

5. That it is the opinion of this House, that it is not expedient to alter the provisions of the Acts for forming a line of railway from Rugby to Oxford, and for forming a line of railway from Oxford to Worcester and Wolverhampton, with respect to the gauge on which they may be formed, nor with respect to the powers therein conferred on the Board of Trade.

*Extension of the Great Western Railway to Porth Dynllaen.*—At a late meeting of the proprietors of the Great Western Railway, convened to give assent to various extensions, and, among others, to Porth Dynllaen in Wales, a strong feeling was manifested in opposition to the measure, and the probability therefore is, that the extension will not be carried into effect. Mr. Dickinson insisted upon the inexpediency of carrying the broad guage into so difficult a country as Wales, which was barren, mountainous, and thinly populated, especially as there would be no carriage of minerals to augment the receipts, and there was no town at the termination of the line. He then read to the meeting the following letter of Admiral Carden, touching the merits of Porth Dynllaen as a harbour:—

"Egham, Surrey, June 11.

"I have no hesitation in replying to your interrogatories respecting Porth Dynllaen as a port of communication with Ireland. I have already given my advice and opinion to the heads of her Majesty's present Government, and hope and believe I have made a just and lasting impression on their minds of the total unfitness of such port for such, or I may say, any purposes of trade or communication. I am a sub-commissioner of pilots for the north coast of Wales, a seaman from and since the year 1788, now a rear-admiral, and was for some years a resident at the Menai Bridge, and to improve the pilotage and navigation of that coast was my constant and chief study during such residence. Porth Dynllaen is situated in the Bay of Carnarvon, and to all seamen, who know or have heard a just description of it, is more to be dreaded than any bay or inlet on any part of our coasts. The Menai Strait being in the centre and inner bight of the bay, causes a constant indraught. The tides at its southern extremity, in the Bristol Channel, are the most rapid of any on our coasts; and in strong winds and heavy gales, which are frequent in winter especially, the swell from the Western Ocean comes with great violence full into the bay with the prevailing westerly winds; and in whatever point the wind may blow from, if strong, the set of the tides, and the various eddies caused by the dividing of the streams, through the Menai Strait and the Irish Channel past Holyhead, baffle the most experieneed seamen, and every year cause the loss of many ships, and generally with their crews.

"(Signed) "JOHN J. CARDEN."

The Chairman appeared to be rather staggered at this evidence, but requested the proprietors to leave the affair in the hands of the directors, under the condition that they would not proceed further in the matter unless they ascertained beyond doubt that Porth Dynllaen would be an eligible harbour, and that the Government was desirous of having a harbour at that place. This consent was reluctantly given, but no person present, except the chairman, opened his mouth in defence of the scheme. The Great Western proprietors appear to be getting tired of experiments, and unless the directors manifest great discretion, the proprietary will, to all appearance, clip their wings.

*Large Locomotive Engines.*—A locomotive engine has lately been tried upon the Great Western Railway, which realizes a speed of nearly sixty miles an hour. The following are some of the principle dimensions; cylinders, 18 in. diam. 2 ft. stroke; driving wheels, 8 ft. diam.; supporting wheels, 4 ft. 6 in. diam.; has six wheels and uncoupled; 278 tubes, 9 ft. long and 2 in. diam.; fire-box outside, 5 ft. 6 in. by 6 ft.; inside, 4 ft. 10 in. by 5 ft. 4 in., with a partition through the middle, giving 160 ft. of heating surface, and 20 feet for area of fire-grate, total heating surface, 1,750 ft.; from level of rail to top of cylindrical part of boiler, 9 ft. 6 in.; and from level of rail to top of chimney, 14 ft. 8 in.; supporting wheels, 16 ft. apart, with the driving wheels in the centre; total length of engine, 24 ft.; tender on six wheels; weight of engine, 30 tons; tender, 15 tons. The broad gauge party have recently made an experimental trip with this engine, and the speed reached, has in their judgment, established the superiority of the broad over the narrow guage. Unfortunately, however, for this conclusion, Messrs. Sharpe, of Manchester, have just turned out an engine which is found capable of maintaining about the same speed, but the weight of which including tender, is only 25 tons. The truth however, is that the speed an engine attains, has nothing whatever to do with the question of guage, except in so far as the resistance of the air is concerned, and there the disadvantage lies with the broad guage. Any power of engine may be put upon the narrow guage as well as upon the broad.

*Summary.*—Sir R. Peel has stated in the Commons, that he is not prepared to advise that there should be any limitation fixed on the capital to be embarked in railways.—The guage controversy has awakened the question, among the Bristol and Exeter shareholders, of the expediency of changing their broad to the national uniform gauge, on the termination of their lease with the Great Western.—Coals, by the agency of the Midland Counties Railways, are now selling in Scarborough at as low a price as 7s. 6d. per ton.—A prosecution is said to have been commenced against several of the persons employed on the Lyons and St. Etienne, in consequence of the late fatal accident on that line.—Mr. Hinde, of the Regent's-park Observatory, has reported to Mr. Stephenson the results of his experiments with mercury at Kensal-green; from which it appears, that at a distance of 644 feet, a down-train, twenty seconds in the tunnel, produced not the slightest vibration, and that the distance where the vibration becomes sensible, and beyond which the train will have no perceptible effect in this locality, is 609 feet. The amount of vibration at this distance being as 1, that at 60 feet is as 100.—The Secretary of the "Metropolitan Labourers' Dwelling Society" states that the directors of the Eastern Counties have intimated to him their readiness to convey the labourers a distance of five miles along their line, for one penny each, morning and evening.—From returns obtained by the *Railway Chronicle*, of about 500 miles of railway now under construction, it appears that there are now employed on these 29,000 men, and 3,000 horses; and as this calculation comprehends one-fourth part only of the lines now in progress, it is assumed that 120,000 men and 12,000 horses constitute the total number employed. The wages paid for these amount to 500,000*l*, per week, or 26,000,000*l*. per annum. Half as much more is also further expended indirectly on labour connected with railways, as in preparing rails, chairs, stock, &c.; and on land and other materials as much more. Moreover, by the engineers' returns, it appears that in order to complete the works in time, an additional supply of nearly 20,000 men is required; or that the proper numbers that should be employed are 48,000 men and 5,000 horses. But these additional men *cannot be obtained*, and any attempt to increase the supply will only enhance prices beyond all probability of profitable investment.—The ability to find sufficient capital for the great railway operations, present and future, is a fruitful subject for discussion. A correspondent of *Herapath's Journal* observes:—During the French war, a period of twenty-two years, the English people lent the Government 601½ millions, being at the average rate of 27½ millions annually—a sum which, if judiciously expended, would be sufficient to construct not only all the necessary railways for the United Kingdom but for the whole of Europe More than this, they raised in the year 1815, by taxes and loans, 170 millions, a sum much greater than all the railways likely to be sanctioned by Parliament this session would amount to, requiring five years at least to construct them.—The proposed Great Central Station of the London and Birmingham, in Birmingham, will be upwards of 300 yards from east to west, and its average breadth 70 yards. It will occupy five acres There will be two sets of goods stations; and the estimated expense is 350,000*l*.—The plans of the Edinburgh and Leith Atmospheric, and the ground purchased for the construction of a terminus, have been sold by auction for 1,600*l*. The North British were the purchasers.—An important decision as to the non-liability of allottees, was announced on the 12th June, in the Exchequer case of Walstab *v.* Spottiswoode. The Lord Chief Baron's judgment is to the effect that, in every case where the ostensible or professed object of the proposed company fails in being carried out, the provisional committee alone are liable for the expenses which may have been incurred, and that any party to whom shares have been allotted is entitled to recover from the provisional committee men the entire amount of deposit paid by such party.—It was stated some time ago that a submarine telegraph was to be laid down across the English channel, by which an instantaneous communication could be effected from coast to coast. The Lords Commissioners of the Admiralty, with a view of testing the practicability of the undertaking, have approved of and given leave to the projectors to lay down a submarine telegraph across the Portsmouth harbour, from the Admiral's house in the Dock-yard to the Gosport railway terminus. When the experiment has been successfully tested at Portsmouth there is no doubt but that both the English and French governments will give their sanction for laying down a submarine telegraph across the straits of Dover.—The preamble of the bill for the enlargement of the Shoreditch station of the Eastern Counties line, and the erection of an engine-house, a goods station at Stepney, and cattle-pens at Stratford, has been proved in committee. The estimate is 100,000*l*.—Several of the provisional committees on defunct schemes are resorting to a new mode of proceeding against defaulting allottees. They are endeavouring to induce those who have paid up their deposits, to sign an assent in favour of the procedure of the committees against those who have not paid up, under pretext of obtaining the funds necessary to clear off the liabilities of the companies.—On the London and Birmingham line, great advantages are offered to the people employed at Wolverton, who besides having excellent cottages provided for them, get provisions &c. from London carriage free, and are even allowed to travel along the line on Sunday on the like enviable condition. These are the beginnings, we hope, of an attempt to make railways accomplish the grand purposes they are destined to fulfil.—The Eastern Union extension of the Eastern Counties line, from Colchester to Ipswich, has been opened for passengers. The cost of this line of rail per mile, stations included, was 20,000*l*.; it was constructed under the superintendence of Mr. Bruff.—The recent decision of the House of Commons, suspending, if not wholly setting aside, the intended passage of the Severn at Hock Crib, will have the effect of still retaining to Gloucester its ancient preference as a thoroughfare, the bridges there being the lowest on the river. This place will be the starting point of the intended Gloucester and Dean Forest Railway, to which the Monmouth and Hereford will throw out a connecting line from Coughton. The Gloucester and Dean Forest line will, for a time, have no direct connexion with the Forest; but the Monmouth and Hereford will be able to connect itself with the Forest at various points.

### ENGINEERING.

*Trial at Law respecting the Screw Propeller.*—The following judgment has been delivered in the case of Lowe *v.* Penn.—*Chief Justice Denman.* In the case of Lowe and Penn: This was an action for the infringing a patent. A verdict having been found for the plaintiff, a motion has been made for a new trial, partly on the ground that there was no infringement of the patent by the defendant, but also, and principally, that the patent itself is void, because the alleged invention is not new. That invention is, by the specification and description of the drawings, both of which are referred to for the purpose, stated to consist in a mode of propelling vessels by means of one or more curved blades, set or fixed on a revolving shaft below the water line of the vessel, and running from stem to stern of the vessel, and it is added, that each of the curved blades is a portion of a curve which if continued would produce a screw. On behalf of the plaintiff, it was not contended that every part of it was new, but that the invention consists in a new combination of those parts; the essential part of that invention being, that the blades must be curved, and each a portion of a curve, which, if continued, would produce a screw. And first, as to the point of infringement; we think it to be indisputably clear, that most of the component parts had been in use, or known before the date of the plaintiff's patent. This was established by proof of the earlier patents of Shorter, Trevethick and Cummerow. In these, or some of them, the position of the machine, that is to say, the aperture being in the dead-wood, the direction of the shaft, with reference to the keel and stuffing-box and curved blades, were the same, except indeed that those curved blades did not form each a portion of a curve, which, if continued, would produce a screw. That at least was not shown, and that, as we have already shown, is the characteristic distinction of the alleged invention of the plaintiff, on which reliance is mainly placed. The question, therefore, as to the infringement comes shortly to this; whether in the defendant's machine curved blades of that particular description have been used or not; because, if they be not curved, but plain, or flat blades, it is obvious that by no number of revolutions would they, or by any possibility could they produce a screw. We are quite aware that there was evidence that the blades of the defendant's machine were curved; but the models which were pronounced to be curved, have been exhibited to us, and upon actual, and we may add, upon a most attentive consideration, we were wholly unable to discover the slighest tendency to curvature, or that the blades were otherwise than perfectly flat, like the plates of a smoke-jack, a specimen of which was also exhibited. Moreover, it does seem to us highly improbable that the defendant, who was contending, and attempting to prove, that he had not infringed the patent, should produce models of such a shape as necessarily to destroy the case which he was attempting to set up. On the other point, however, whether the alleged invention be new, some of the observations already made have a material bearing. It appears, that in the patents of Trevethick and Cummerow already referred to, a screw of one or more turns was in use, and in the description of the drawing, to which reference is made by the plaintiff, in support of his specification, the use of a complete screw is mentioned. Would then the reduction of a complete screw to an uncertain aliquot part of a fraction of it be an invention? We say uncertain, because the precise section or portion of a screw which is to produce the desired effect is not defined. "One or more curved blades," is the language of the specification, without any attempt to define, or even to approximate to the precise number which is best for use. In the case of Heath and Unwin, 13, Meeson and Welsby, cited at the bar, the patent was for an improved manufacture of steel by the use of a metallic substance, called carbonate of manganese, in that stage; and the other materials in the process were to be used along with from one to three per cent of their weight of carbonate of manganese. The defendant had by the use of other materials, to him unexpectedly, produced that substance, but, in a less quantity than one per cent. in weight of the steel in the crucible. That was so found by the jury, and the Court referred to the finding in their judgment; and if that be material, it seems to show that *the quantity* of carbonate and manganese to be used in the process of that patent is material also. In the present case, as has been observed, there is no attempt to specify the precise amount to be subtractible from a complete screw that had been before in use. It does not appear this latter point was pressed at the trial. I am not quite sure that it was not, if indeed it was presented at all. It seems however to raise sufficient doubt to require the distinction to be raised, and to furnish a reason for the case undergoing revision, in addition to that already mentioned as to the proof of being satisfactory, to show an infringement of the patent, even if it be valid in point of law. Upon the whole, we are of opinion that the rule must be made absolute for a new trial.

*Steam Navigation Bill.*—The Bill for the regulation of Steam Navigation, requires that every steamer shall have two water tight partitions, separating the engine room from the other parts of the ship. That every sea-going vessel shall carry not less than the complement of boats given in this table.—

| Tonnage of vessel. | Number of Boats. | Long Boat. | | | On Deck or Quarters. | | | | | | Astern. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Leng | Breadth | | Leng | Breadth | | Length. | Bre th | | Length. | Breadth | |
| | | feet. | ft. | in. | feet. | ft. | in. | feet | ft. | in. | feet. | ft. | in. |
| 1,000 and upwards to 850 | 4 | 26 | 8 | 0 | 24 | 7 | 0 | 22 | 6 | 6 | 16 | 5 | 6 |
| 850 to 550 - - - | 4 | 24 | 7 | 0 | 22 | 6 | 6 | 18 | 5 | 6 | 16 | 5 | 6 |
| 550 to 350 - - - | 3 | 20 | 6 | 6 | 18 | 5 | 6 | — | - | - | 14 | 5 | 0 |
| 350 to 200 inclusive - | 2 | 18 | 6 | 0 | — | - | - | — | - | - | 14 | 5 | 0 |

and that no sea-going Vessel under two hundred tons, and above —— tons shall proceed to sea unless provided with a dingy, and with a boat sufficiently large to carry ten persons, and in every case, one boat to be carried outside, on the quarter or on the stern, shall be fitted up as a life-boat

### MISCELLANEA.

Letters from Reikiavik, in Iceland, mention that the whole Southern portion of Iceland is disturbed by frequent shocks of earthquake; which the inhabitants consider as announcing a fresh eruption of the volcano only just gone to rest.—The *Geelong Advertiser*, an Australian paper, reports that there is now to be seen at the South Geelong, a stone which was found on the banks of the Leigh, which bears every appearance of being a petrified mummy, or human body. The head, nose, ears, and chin, are in good proportion, the neck and shoulder-blade also well developed; but the hips and thighs are twisted half round, as if the body had been crushed by a heavy substance falling upon it. Whether the stone be really what it appears to be or not, it is nevertheless a singular curiosity. The stone appears to be hollow, except in the head.—The Duke of Northumberland's tile manufactory, near Belford, is said to be capable of turning out 1,000,000 tiles in the season, One workman can turn out nine bricks in one minute. Etheridges patent machine is at work, producing 8,000 tiles, equal to 4,000 tiles and 4,000 soles a day. The drying sheds are calculated to hold 38,000 tiles; and the two kilns, when finished, will contain 20,000 each.—Dr. Gardner has suggested that it may be possible to obtain from coal, a solid, dry, portable hydrocarbon, capable of being made a substitute for wax and tallow in the fabrication of candles, and so cheap as to supersede animal fat in lighting the humblest cottages.—Professor Liebig has announced that a residue left in the manufacture of sulphate of quinine is the pure alkaloid itself, merely obscured by its form. During the twenty-six years in which sulphate of quinine has been manufactured, a considerable portion every year of the pure alkaloid has been laid aside, and a considerable amount has thus accumulated. Professor Liebig's discovery will not only bring this into use, but it will enable the practitioner of medicine to prescribe the pure alkaloid, and to combine it at pleasure with vegetable or other acids, and thus to obviate the objections which are found in practice to lie against the sulphate of quinine, placing at command quinine and a variety of its salts, at a price which will not preclude the poorest from its benefit.—Dr. Ambrose Baber, of Macon, Georgia, wrote a prescription for a dose, composed in part of prussic acid, to be administered to a patient. The druggi t sent the medicine, with a message that whoever took it would be killed. The patient thereupon refused to take it, when the Doctor, to convince him there was no danger, swallowed it himself, and died in half an hour. The prescription was copied exactly from a medical work, but the quantity of prussic acid was eight times greater than it should have been. —A Mr. Brookhouse, Roman cement manufacturer, of Derby, having lately died, a thick layer of cement was spread at the bottom of the grave before the coffin was lowered, and the sides and ends were then filled, and another layer of cement at the top hid the coffin from view, and rendered it air-tight. Before the cement had hardened, which it quickly did, the deceased's name was traced in the yielding mass; so that at a future period, should the grave be opened, the name of the occupant will be clearly discernible.—Considerable opposition is manifested throughout the country to the new Highway Bill, now before Parliament. The objectors assert that surveyors of highways, appointed under the existing system, are more competent to discharge the duties of the office than any comparative stranger could be, in consequence of their local knowledge;—that it is the interest of the present surveyors to employ the poor of their respective parishes—that the proposed change would take the management of parish matters and parish monies out of the hands of the parishioners—that it would be attended with increased expense, which country districts are ill able to bear —and that it would be unjust towards parishes which have been well managed, to make them pay for the negligent management of others.—A letter from Florida, published in the *Montreal Times*, states that the oil of the alligator is better for lamps than even whale oil, and is extracted from the animal in quantity varying from half a barrel to a barrel, in one eighteen feet long. It is said that the Indians have been in the habit for a long time of extracting the oil of the alligator and using it for various purposes.—In a recent account of the climate of Algeria and the diseases peculiar to it, M. C. Broussais describes some of the effects of the sirocco, or hot desert-wind. When it blows strong, the sky becomes grey, sometimes reddish; the horizon is darkened, and the air becomes charged with a light dust, which is carried off towards the sea, over which it forms a kind of cloud. If a window is opened during the continuance of the sirocco, the air which enters is intensely hot, just as though it came directly out of a furnace, and it causes great irritation of the skin and eyes. The air which enters the lungs is stifling; and after incessant efforts to breathe, a sense of fulness in the head, with giddiness, confusion of intellect, and complete inability to make any effort, comes on, and the person eventually falls exhausted and overcome. So dry and hot is this wind, that the leaves of the trees are shrivelled and hardened by it, and even paper cracks and curls up. A person who has often been on the borders of Sahara informs us that he has found the water skins on the camels which had been packed in a box surrounded with earth for greater security, dried up by this wind so that they crumbled in the hand as if they had been scorched by fire. Yet this country is inhabited.—The Italian Scientific Congress, which for the last seven years has been held annually, is to take place this year at Genoa, that city having undertaken to contribute 6000 francs for the expences of the experiments to be made during the session. All scientific foreigners who may wish to suggest particular experiments are requested to send in their proposals to the committee of the Congress at Genoa, before 15th July. —When the Grand Junction line was opened, only one goods trains passed nightly up the line; but now there are fifteen, each containing half as much more as the one did.—In the *Annuaire* for the present year, presented to the King of the French by the Bureau of Longitudes, M. Arago takes occasion, once for all, to dispose of those weather-predictions which annually make the circuit of Europe falsely stamped with his authority. "No word," he says, "has ever issued from any mouth, either in the intimacy of private communication or in the courses delivered during thirty years—no line has ever been published with any assent—which could authorize the attribution to me of my opinion that it is possible, in the present state of our knowledge, to foretell with certainty what the weather will be, a year, a year, a month, a week,—nay, I will say, a single day, in advance."

# THE ARTIZAN.

No. XX.—New Series.—AUGUST 1st, 1846.

## Art. I.—MR. WHITELAW'S EXPERIMENTS ON BARKER'S MILL, WITH REMARKS UPON TURBINES.

The numbers contained in the ninth column of the second table in our last article on Barker's mill were obtained by multiplying the results given by equation R by 12·5 (= 100 per cent., ÷ 8, the height of the fall in feet). As the reason for using the multiplier 100 ÷ 8 will be obvious enough, no farther explanation need be made regarding the numbers referred to.

Eight feet is the height of fall the fourth and sixth series of experiments were made with; but there is a loss, = 4·71125 per cent. of the whole power, occasioned by the resistance the water meets with in passing through the water-mill and pipes; for it was found by the trials made while the water-mill was prevented by the friction-brake from revolving, that the velocity of the issuing water then was the same as that due to a fall of only 7·6231 feet. And, as 7·6231 feet is = 95·28875 per cent. of 8 feet, we have 100 − 95·28875 = 4·71125 per cent., = the amount of loss the water met with in passing through the arms and pipes while the water-mill was kept from revolving.

As 4·71125 per cent. of the whole power of the water was lost when the machine was not in motion, and as the expenditure of water then was 4190·725 ounces in 40 seconds, the amount of loss due to any other quantity of water which might pass through the water-mill in the same time, can at once be ascertained by the following proportion, which was used for calculating the numbers contained in the 10th column of the table above referred to.

*Proportion*:—$4190{\cdot}725^2 : 4{\cdot}71125 :: $ other quantity of water squared : per centage of loss due to that other quantity of water.

*Example*:—Take 5446·234 for the quantity of water expended in 40 seconds. Here $4190{\cdot}725^2 : 4{\cdot}71125 :: 5446{\cdot}234^2 : 7{\cdot}95702$. And as 5446·234 is the fifth number in the fifth column of the second table in our last article on the subject of Barker's mill, 7·95702 is the corresponding number contained in the tenth column of that table.

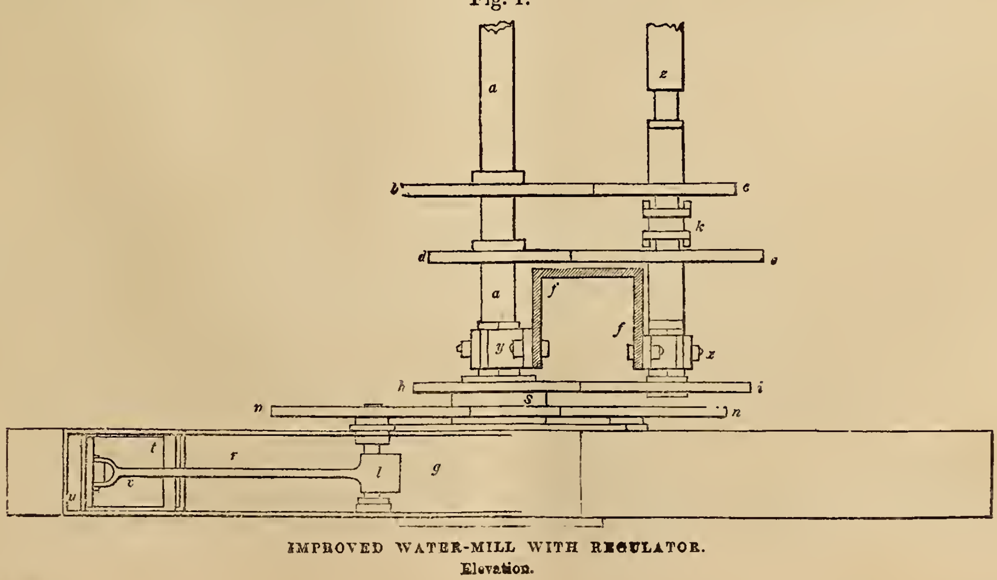
It already has been shewn that formula B is correct, and another proof that formula V is correct is furnished by the fact that the power of the water-mill + that lost on account of the resistance the water meets with in passing through the water-mill and pipes + the amount of power which passes away with the escaping water is exactly = the whole power of the water. By inspecting the eleventh column of the table already referred to, this will be seen to be the case.

If formula B and V be correct, the water-mill, with which the fourth and sixth series of experiments were made, would have given a result as high as 78·3 per cent. of the whole power of the water, had it not been retarded by the one arm striking against the water which left the other, by the spray, the atmosphere, and by the friction on the bearings of its spindle. But as the water-mill can be so formed that the resistance occasioned by the spray, and that caused by the one arm striking against the water which leaves the other will be entirely removed, and as the friction on the bearings and the resistance of the atmosphere are very trifling, we shall err on the safe side if we reckon that Barker's mill is capable of giving an available power = 78·3 per cent. of the whole power of the water by which it is actuated. As we have mentioned that 78·3 per cent. of the power of the water would have been that of the water-mill, with which the fourth and sixth series of experiments were made, had it not been retarded by the causes explained, we may further state that 299 revolutions in 40 seconds would have been the best speed for that machine to work at, had those counteracting forces not been in operation.

Equations H, I, K, L, M, N, and O can easily be modified to suit the results equations B and V give.

As the fourth and sixth series of experiments gave the lowest results of any that were obtained from the water-mill of 1·3 feet diameter, it is reasonable to suppose that a result greatly higher than 78·3 per cent. may be realized from Barker's mill. If the water-mill of 1·3 feet diameter had had arms of a greater cross-sectional area, this would have improved the machine to some extent; and, as it is not to be thought that the form of its jet-pieces is the best that can be made, this makes it likely that a result higher than that now stated may be safely reckoned on after a little time. If the loss occasioned by the resistance the water met with

Fig. 1.




IMPROVED WATER-MILL WITH REGULATOR.
Elevation.

Drawn & Engraved by Henry Shaw.

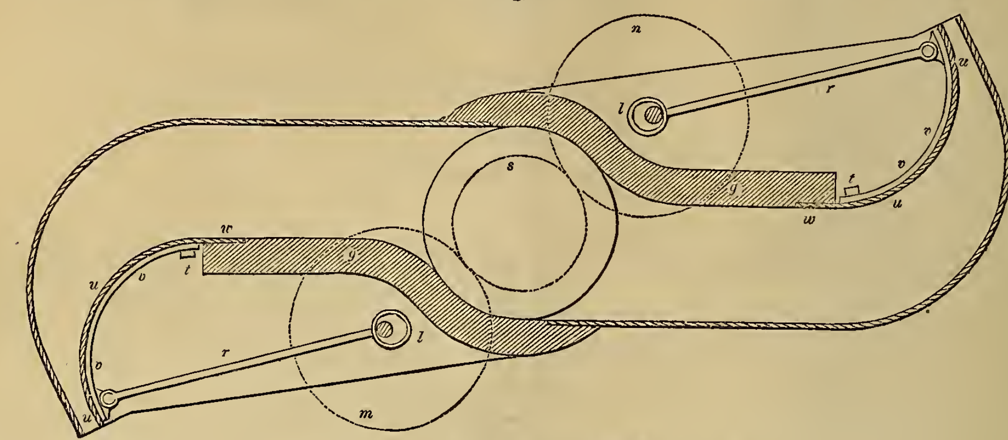
HARDWICKE HALL,

ENTRANCE FRONT.

in passing through the water-mill and pipes while the water-mill was at rest, had been 4 in place of 4·71125 per cent., the best result in place of 78·3 would have been upwards of 80 per cent. These things are mentioned to shew that it is very probable that Barker's mill may be made to utilize even more than 78.3 per cent. of the power of the water, although it must be admitted that the results already obtained from that motor have been more than satisfactory. Bye and bye the results of some new experiments will be given to shew what amount of power may be realized fromthat kind of Barker's mill which has its discharging orifices made in thin plates.

One of the many plans of regulating the speed of Barker's mill is shewn in figs. 1 and 2. *a, a,* is the spindle or shaft of the water-mill; *b, e, h, i, m,* and *n* are spur-wheels, and *c, d,* and *s* spur-pinions. A rod, *r,* connects each regulating valve, *u, u,* with an eccentric, *l.* The wheel, *b,* and the pinion, *d,* are keyed on the upright spindle, *a, a*; the pinion, *c,* and the wheel, *e,* work loose on the spindle, *z,* and the other wheel, *i,* is fastened to the bottom end of the same spindle. The pinion, *s,* and the wheel, *h,* are fastened together, and they work loose on the spindle, *a, a.* On the spindles of the eccentrics the wheels, *m* and *n,* are keyed. Each thick plate of metal, *v, v,* is for preventing the pressure of the water from bending the thin plates or valves, *u, u.* One end of each plate, marked *v, v,* is supported by the bar, *t,* and the connecting rod, *r,* supports the other end. Each of the valves is rivetted at the outer end only to the plate which supports the pressure on it, that is, the valve and plate are rivetted together at the end next the connecting rod, and not at the other end. The valves work in the space betwixt the top and bottom plates of the water-mill; each valve is rivetted at the end, *w,* to the part, *g,* and, as they are very thin, they readily bend as much as is required for regulating the width of the discharging orifices. Very little water can escape betwixt the top and bottom edges of the valves and the top and bottom plates of the water-mill, as the valves are accurately fitted in betwixt those plates. The valves might be packed so that no water could escape past their top and bottom edges, but it is scarcely necessary to do this, for if they be accurately fitted in betwixt the top and bottom plates, very little water can escape at the places mentioned. *f f* is a cast iron beam supported by the side walls of the mill-pit; the bottom plumber-block, *y,* of the shaft, *a, a,* and the undermost bearing, *x,* of the spindle, *z,* are both bolted to that beam. *k* is a catch-box, so constructed that if it be pushed in gear with the pinion, *c,* the spindle, *z,* will be turned by the wheel, *b,* which gears into that pinion, and if the catch-box be put in gear with the wheel, *e,* the pinion, *d,* as it gears into that wheel, will turn the spindle, *z.* As the wheels *h* and *i* are of one size, and gear into each other, it will be evident that when the catch-box is in gear with the pinion, *c,* the wheel, *h,* will revolve a little quicker than the spindle of the water-mill, and it also will be clear that the wheel, *h,* will revolve somewhat slower than that spindle if the catch-box be in gear with the wheel, *e.* It already has been mentioned that the wheel, *h,* and pinion, *s,* are fastened together, and as the wheels, *m* and *n,* both gear into the pinion, *s,* it will be evident that the eccentrics will be turned round in one direction, if the catch-box be in gear with the pinion, *c*; and they will be turned the opposite way when the catch-box is connected with the wheel, *e.* Suppose the eccentrics to be turned either way, say one-fourth of a revolution from the positions they occupy in figs. 1 and 2, so as partly to shut the regulating valves, it will be clear that those valves may either be closed farther still, or opened simply by shifting the catch-box up or down on the spindle, *z,* according as the valves are to be moved the one way or the other; and as the width of the discharging orifices may in this way be increased or diminished at once, the speed of the water-mill can be regulated without much trouble. It is scarcely necessary to mention that as the wheel, *e,* and the pinion, *c,* run loose on the spindle, *z,* that spindle is turned by the wheels, *h* and *i,* when the catch-box is in the position shown in fig. 1, that is, when the catch-box neither is in gear with the wheel, *e,* nor the pinion, *c,* the spindle, *z,* is turned by the wheels, *h* and *i.* An apparatus of a similar kind to the governor of a steam-engine, but of a simpler construction, might be used for shifting the catch-box, or it may be shifted by hand, which will be the better way in cases where the speed of the water-mill is wanted to be greater at one time than another. In cases where a very uniform speed is required, the governor, or rather the parts which act by centrifugal force, might, in addition to shifting the catch-box, be made to act on a friction brake, having its pulley on the spindle of the water-mill.

Fig, 2.




IMPROVED BARKER'S MILL WITH REGULATOR.
Horizontal Section.

The promise made in our last article on Barker's mill leads us to make at this time a few observations on the work entitled—

" *On Horizontal Water-wheels, especially Turbines, or Whirl-wheels; their History, Construction, and Theory. Illustrated for the use of mechanics. By* MORITZ RUHLMAN. *Edited, with an introduction and notes, by* SIR ROBERT KANE. *With six plates and tables of calculations.* Dublin: Printed for Hodges and Smith, booksellers to the University. 1846."

We shall begin with the first paragraph of the editor's introduction, principally because it explains the motives which induced him to translate Professor Ruhlman's work:—

"When occupied with the consideration of machines for economising water-power in my recent work on the 'Industrial Resources of Ireland,' I took occasion to direct public attention to the peculiar properties of the machine recently invented in France, and to which the name of '*Turbine*' had been given, and to suggest it as applicable to a greater variety of circumstances than any other water-engine, whilst it appeared to utilize, at least, as as great a proportion of the available force. The brief description of it which I then gave had the effect of exciting a great number of millwrights and manufacturers to specific inquiries as to its mode of construction and practical results, and very many applications were made to me for further information on the matter. I endeavoured, to as great an extent as possible, in my private correspondence, to satisfy those inquiries, but refrained from interfering publicly in the matter, in the expectation that some one of our mechanical engineers, whose eminent competency is so well known, might be induced by the remarkable interest which the subject had excited, both on the continent and in Ireland, to occupy themselves with the matter, and either translate and edit some of the works that have been written on the subject abroad, or else bring out some practical essay on the subject, of their own original composition. This, however, not having been done, and their being, so far as I am aware, really no means by which millwrights and manufacturers, not in intimate connection with foreign scientific literature, can at present know the precise construction and capabilities of those machines, I have been induced to select for translation and publication an Essay by Professor Ruhlman, which, although in a literary or purely mathematical point of view, probably not the most finished of those that have been written on the subject, yet appeared to me decidedly that of most directly practical bearing, and that to which a person desirous of knowing the nature and powers of the turbine could refer with the greatest satisfaction."

We do not understand why Sir Robert Kane "took occasion" "to suggest it" (the turbine) "as applicable to a greater variety of circumstances than any other water-engine;" and say that to him "it appeared to utilize at least as great a proportion of the available force," when the facts of the case are, that the turbine is not applicable to anything like so great a variety of circumstances as Barker's mill is; and the overshot or breast-wheel, as also Barker's mill, will utilize much more of the available force than the other hydraulic motor we have named is capable of doing. The readers of the "ARTIZAN" will know this to be the case, and it therefore is not necessary to give our authority for making these assertions.

After reading the above extract, we are led to suppose that Professor Ruhlman's essay should have contained at least one good representation of the turbine in its best form, but as it does not, practical men will be but little benefitted by the translator's labour.

As the paragraph we have quoted gives Sir Robert Kane's ideas of the turbine, our next extract will be taken from Professor Ruhlman's work, to shew what he thinks of that kind of hydraulic motor :—

"It is certainly not true that turbines are capable of totally displacing vertical water-wheels, as was at first asserted.

"The greatest obstacles to the erection, construction, and working of turbines, at least in Germany, arise from the fact that many years must elapse before our millwrights will have acquired the necessary theoretical knowledge and practical experience. With these machines everything must be really calculated. It will not do to construct one wheel after the pattern of another, or to trust to what is called the practical shape. But also the construction of these wheels, in the workshop of the machine-maker, requires the greatest care, observation and prudence, otherwise, no matter how it may be calculated, a good wheel cannot be produced.

"It is now also fully admitted that Fourneyron deceived himself in supposing that these wheels economised 80 per cent. and more of the total available force. But the latest and fullest experience has shewn that they economise certainly from 60 to 70 per cent., when those precautions are taken which should be attended to in their formation.

"Finally, as to the choice between vertical wheels and turbines, in any particular case, it is decidedly to be considered that in every case where an overshot-wheel, or a wheel with tolerably high breast, and what are termed overfall sluices, can be erected, such is to be preferred to the turbine, since the former, when carefully constructed, easily economises more than 70 per cent. of the power. Yet in cases, as in corn-mills, where the horizontal motion of the turbine may be immediately made use of, or where there is much back water to contend against, this assertion may require to be modified; since, as mentioned already, the turbine may be sunk to a considerable depth in the back water, without loosing any material proportion of its power.

"In every case of a fall, either higher or lower than that suitable for an overshot-wheel, the turbine deserves decidedly the preference, and their not being erected in all such localities can only arise from want of knowledge, the apprehension of their being badly made, or of their cost being greater than that of the vertical wheel, which it should not really be."

This makes it evident that Professor Ruhlman does not entertain so high an opinion of the turbine as that held by the translator of his essay. Yet for all that, we cannot help thinking that even *he* overrates its performance when he asserts that from 60 to 70 is the co-efficient which represents its efficiency; and he certainly underrates the value of overshot and breast-wheels when he says that they easily economise more than 70 per cent. of the power. Smeaton's experiments make it certain that upwards of 80 is the co-efficient of effect for overshot-wheels, and recent experiments prove that a properly constructed breast-wheel will give nearly as high a result as any that can be obtained from an overshot-wheel. It appears to us that the turbine cannot be made for so small a sum as M. Ruhlman thinks it should cost; and if our views on this point are correct, a principal argument in favour of that kind of water-wheel is done away with. Besides, the turbine is a delicate machine, and it is very liable to get out of order; it is questionable, therefore, whether it would not be better, in many cases, to use a vertical wheel, even if its first cost were greater, rather than be subjected to the inconveniences incidental to the delicacy and complexity of the turbine; and if German mechanics have neither the theoretical knowledge, nor the practical experience, requisite for the construction of a good turbine, if they cannot exercise a sufficient degree of care, observation, and prudence, to enable them, notwithstanding all their trials, to make an efficient instrument of that description, it is hard to see in what way the mechanists of Ireland can have any magnificent prospect of success.

In the third paragraph of the introduction, the translator says :—"The action of the turbine, considered as a problem of hydrodynamics, involves conditions, to the discussion of which science, in its present state, scarcely reaches; and, therefore, whilst the present theoretical exposition of the machine supplies the principles of construction in a certain degree, the observation of the faults or the advantages of the machines so constructed will afford the means of correcting the principles on which the theory is based, and of thus deriving from a more perfect theory a form of mechanical arrangement producing still greater practical advantages than are at present obtained." In the course of these observations, a simple enough theoretical exposition of the turbine will be given, to suit the form of mechanical arrangement we consider the best.

Sir Robert says, that an experimental examination of the turbine has led to the following amongst other conclusions :—

"2. That they transmit a useful effect, equal to from 70 to 78 per cent. of the absolute total moving force." This certainly does not agree with Professor Ruhlman's opinion or with our own.

"3. That they may work at very different velocities, above or below that corresponding to the maximum effect, without the useful effect varying materially from that maximum." This remark will apply equally well to the overshot and breast-wheel, and to Barker's mill, and therefore the turbine has in this respect no decided advantage.

"4. That they may work from one to two yards deep under water, without the proportion which the useful effect bears to the total force being sensibly diminished." While we believe this to be the case, we at the same time think that it argues against rather than for the turbine. The ordinary kind of turbine is so formed that the whole of its outer edge or circumference will, while the machine is in motion, keep in contact with the escaping water, and thus, in effect, the turbine is, to a great extent, constantly working in water, even when it is placed entirely above the water in the tail-race; this, as a matter of course, greatly reduces its power, and constitutes one reason for our belief that the capabilities of the turbine are not high. As the form of the turbine is such that its outer edge or circumference will meet with far more resistance by being in contact with the water than both its top and bottom sides put together, it is not difficult to see why the turbine works nearly as well when buried in the tail-water as it does when placed entirely above the surface of the water in the tail-race. On the same principle that the hydraulic-belt lifts water will the outer edge of the turbine communicate motion, and consequently give away some of its power to the escaping water. Were it not that the turbine is, in effect, always working in water, even when it is kept entirely out of the water in the tail-race, the principle on which it acts could easily enough be explained. The plan of turbine which will afterwards be given will not be subject to the disadvantage now pointed out, if the machines made according to it be worked out of the water in the tail-race.

"6. That they may receive very variable quantities of water without the relation of the useful effect to the force expended being materially lessened." The overshot and breast-wheel, and Barker's mill with a proper regulating apparatus applied to it, are in this respect far superior to the turbine.

M. Ruhlman in his preface lets it be known that a German mechanic discovered that "it is indispensible to regularly oil the bearings of the turbine." As this seems to be the most important remark contained in the author's preface, we shall pass it over and proceed to examine the body of his work.

Professor Ruhlman gives his opinion of Barker's mill in what follows :—

"The theory of this wheel has been given in all its details by Seyner, the two Eulers, Waring, Ewart, and in latter times by Navier, from which it is shewn that the degree of effect produced by such a wheel may be tolerably great, provided that it moves with its greatest possible velocity; that the escape apertures are very small in proportion to the diameter of the tubes, and that no obstacles should occur in the latter which might produce a sudden change of velocity. Nevertheless, its power can never amount to more than 0·5 or 50 per cent. of the available *vis viva*, since a sudden change of velocity before the issue of the water into the air cannot be avoided in practice; besides which, adhesion in the sides of the tubes, contraction of the orifices, friction of the axis, &c. &c. remains quite unnoticed."

This paragraph does not express a single idea that is correct. To assert that no more than 50 per cent. of the power of the water can be realized from Barker's mill, even if the disadvantages arising from the adhesion of the water to the sides of the tubes, the contraction of the orifices, and the friction of the axis, &c. &c. could be done away with, is so completely at variance with the facts of the case, that we wonder how Sir Robert could have let the matter pass without giving his readers a "note" by way of explanation.

The following is the paragraph next after the above :—"Lastly, as to the practical applicability of these wheels, various obstacles have become known, from which it is evident that it is not easy to preserve a sufficient contact of the movable with the immovable parts of the machine."

In answer to the allegation contained in this paragraph, we have only to state that the water-tight joints planned and made by Mr. Whitelaw are so very tight that they do not allow even a *single drop* of water to escape, and for all this there is not much friction at the joint,—so little, indeed, that we have seen a very large machine that could be turned with the greatest ease by a person applying his hand to one of the arms, every part of the machine being in working order at the time. Here, again, a note from Sir Robert would have benefitted his readers.

Our next extract will give Professor Ruhlman's own account of his visit to one of the turbines erected by Fourneyron :—"The second turbine erected by the inventor at St. Blasien, with a fall of 117 yards, has become more important than any other. I can best describe this turbine by detailing what I myself saw and learned upon the spot during the journey already referred to. Already, half an hour before arriving at the remarkable locality of St. Blasien; situated in one of the most beautiful, but also of the wildest and loneliest parts of the Schwartzwald of Baden, a curious noise announces the uncommon spectacle, which becomes more extraordinary as you approach.

"On entering into the wheel-room one learns there, that what had been heard at a distance about this place was not merely mystification, but reality. One then feels seized with astonishment, and wonders, more than in any other place, at the greatness of human ingenuity, which knows how to render subject to it the most fearful powers of Nature.

"At every moment the powerful pressure appears likely to burst in pieces the little wheel, and the spiral masses of water issuing from it threaten to destroy the surrounding walls and buildings. Often when I went out of the wheel-room, and looked at the enormous height from which the conducting tubes bring down the water to the wheel, the idea forced itself upon me "that it was impossible;" but that idea passed away when I went back into the little room.

"Fourneyron has here, for the first time, solved a problem, which will for ever render his name historical in the technical and scientific world, a problem in which he had to overcome not only the greatest obstacles of Nature, but also disfavour and prejudices in a thousand forms. Who could find any other means of utilizing this existing water-power? Perhaps a water-pressure engine might be applied? Certainly not; since even without proving, by calculation, how little that kind of machine is suited for rotatory motion, it is only necessary to consider the very difficult and very power-destroying conversion of a vertical reciprocating motion into an uniform rotatory motion, in order to sufficiently appreciate the difficulties."

"A residence for many days in this place, which had become so interesting to me, enabled me to sufficiently understand all its arrangements and constructions, to be able to give a sketch of the prinicpal parts of this turbine, and particularly to undertake the construction of the wheel-paddles, although it was not allowed me to take asunder and copy the entire."

We have given the above extract partly because we take it to be a specimen of what the translator would call "foreign scientific literature," and also for the reason that to us it appears to show that Professor Ruhlman's mind, at the time he examined the turbine, was scarcely in a proper state for such investigations. We have next an imperfect description of the different parts of the turbine at St. Blasien, and then there is the following account of its performance:—

"The diameter of the wheel is, as shown by the drawings, not greater than 316 millimeters, or about $12\frac{1}{2}$ inches, and the number of its revolutions, with from 9 to 10 millemeters, or from thirty-three-hundredths to thirty-nine-hundredths of an inch of sluice opening, was between 2,200 and 2,300 in a minute. In each second there was about a cubic foot of water expended, and the total height of pressure, or available fall, was 108 meters, or 351 feet.

"The supply of water must be collected from streams on the surrounding hills, more than $\frac{2}{3}$ of a league distant from St. Blasien. These streams are first collected into a reservoir, and are brought from thence to the wheel in a conductor, formed of 300 pieces of cast-iron pipe joined together, and each of 4 feet long, and about 18 inches diameter. It is worth mention that the strength of these tubes increases from above downwards only from four to five-tenths of an inch.

"At present this wheel drives a cotton-spinning factory of 8,000 water spindles, the roving-frames, carding-engines, and all other accessory machinery."

We scarcely pretend to comprehend the meaning intended to be conveyed by the first and last of the paragraphs we have here quoted. But it appears to us that they must mean that with a fall of 351 feet, and about 60 cubic feet of water per minute, the turbine at St. Blasien drives 8,000 throstle spindles, with preparation. If we are right, then $60 \times 351 \div 700 = 30$ H P, that is, taking the power of the turbine = 75 per cent. that of the water, 60 cubic feet of water per minute on a fall of 351 feet would give a power = 30 horses. And $8{,}000 \div 30 = 267$ = the number of spindles worked by each horse power. As it has been proved by experiment that one horse power is capable of driving not more than about 120 throstle spindles, with preparation, and it therefore would take 67 in place of 30 horses power to work the cotton-spinning factory at St. Blasien, we do not see how M. Ruhlman is able to reconcile this statement of facts with the statement we have just cited from his essay. It may indeed be said that it took 30 horses' power of water to drive the turbine with no load on it at a speed of between 2,200 and 2,300 revolutions per minute, but this view of the matter does not place the turbine in a favourable light, for if it required as much water as would have given, with any good kind of hydraulic motor, an available power of 30 horses to work the turbine alone at a velocity of less than four-fifths, that which a heavy body would acquire in falling a distance equal to the height of the fall, this would show that only a small fraction of the total moving force of the water could be rendered available for driving the factory, or for any other purpose.

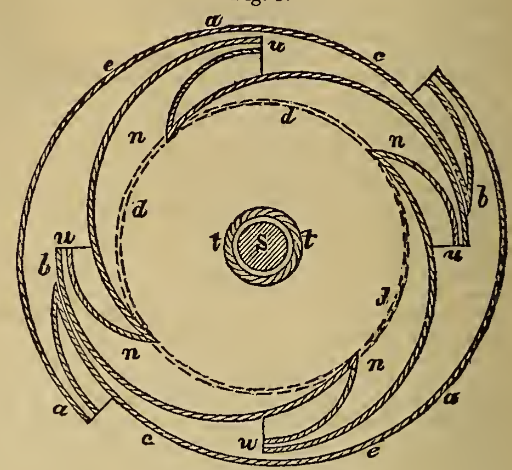
A "*paddle-board*" is one of the curved plates which, in the revolving part of the turbine, separate one passage for the water from another, and the "*guide-curves*" are the corresponding plates in the stationary part of that machine. When treating of these Professor Ruhlman says:—

"Neither the number of paddle-boards nor that of the guide curves can be positively determined by theory, and yet it would be very incorrect to assume that the same number would answer for different turbines. The number appears to depend principally upou the available quantity of water, and must be greater as more water is discharged in a second. In any case a large number of paddle-boards is an advantage, when they are formed of thin sheets, as thereby a greater number of threads of water act directly on the paddle-boards, and not indirectly, through a mass of other water interposed."

From a note we learn, that Fourneyron has 36 paddle-boards and the same number of guide-curves in his turbines, and Carliczeck recommends 42 paddle-boards, and 28 guide-curves as being correct. As we proceed, however, Professor Ruhlman's notions are becoming quite at variance with ours. His theory of the turbine seems to depend on the real existence of *threads of water*, and as it is our belief that they are nowhere to be met with, we leave him in the hope that he will by and bye throw some light on this part of the subject. In the meantime we shall content ourselves by describing the new kind of turbine, to which we have already referred.

Fig. 3 is a plan of the turbine: *a, a, a,* is the outer or revolving part.

Fig. 3.




IMPROVED TURBINE.
Horizontal Section.

There are only two passages for the water to run through in that part, and they are marked *b*. The inner or stationary part has four passages for conducting the water from the main-pipe to the revolving part; each of these passages is marked *n* in the figures. The dotted circles, *d, d, d,* represent the main-pipe; the spindle is marked *s*, and *t, t,* is the tube which surrounds the spindle. The top and bottom plates must be cut away at *c, e,* and *e, c,* on purpose to prevent the revolving part from being retarded by the escaping water adhering to these parts of the plates, and the top and bottom plates of the stationary part of the turbine should also be cut away at the four places marked *u*, in order to allow the water to pass freely from the fixed to the revolving part. In the figure the stationary part is represented a trifle too large in diameter. According to fig. 3, the fixed part has only four passages for conducting the water from the main-pipe, but it could do no harm to increase the number of conducting passages in that part. One thing to be attended to is that the water which issues from the fixed part should on no account touch or come in contact with that part after it has left the outer ends of the conducting passages. It is not a good plan to regulate the speed, or, what is the same thing, the power of the turbine, by means of a circular sluice, as is generally done, but the speed should be regulated by increasing or diminishing the width of the discharging orifices in the stationary and revolving parts by valves, similar to those shown in fig. 2. The valves should be so constructed that they will all act to the required extent, at the same time. Instead of taking in the water above, it may be let in below the turbine; and if this be done, the weight of the revolving parts can then be balanced by the pressure of water in the main-pipe in the way we shall now explain. To the bottom end of the spindle of the turbine, a circular plate will be fastened, which plate will revolve in a hole bored out to receive it in the end of the main-pipe. The circular plate will require to be so large in diameter that the pressure of water on it will nearly balance the parts to be supported, and a water-tight joint, similar to the one already made mention of, must be used to keep any water from escaping through the small annular space which will be left between the revolving plate and the side of the hole it will work in.

The revolving part will be carried round by the water which issues from the part that is fixed, and the centrifugal force due to the revolving water will press the water through the tapering passages, *b* and *b*, and make it act in the revolving part in a manner very similar to that in which it operates in the jet-pieces of Barker's mill. While Barker's mill is in motion, the pressure in its jet-pieces is equal to that due to the fall of water plus the pressure due to centrifugal force; but when the inner periphery of the revolving part of the turbine now described turns with a velocity the same as that of the water issuing from the part that is at rest, the pressure in the passages, *b* and *b*, will be equal to that due to the rotatory motion of the revolving part, and neither more nor less than that amount. By following out the hint now given, we shall be able to determine in what respect the action of the water is different in the one machine referred to from what it is in the other. We may here give it as our opinion that the turbine last described will, if it be properly constructed, utilize more of the power of the water than Barker's mill is capable of doing, but then the latter is the preferable machine, in so far as simplicity is concerned. The jet-pieces of the fixed, as also those of the movable part of the turbine, should taper outwards, as shown in the figure, that is, their form should be similar to that of the jet-pieces of Barker's mill. The water should enter the revolving part as nearly in the direction of a tangent to its inner periphery as possible, and it should leave that part in the direction of a tangent to the circle which the centre of its discharging orifices would describe if that part were turned round, or made to revolve. As before mentioned, it is to be observed that the turbine should be so constructed that the outside of the one jet-piece will not strike or come in contact with the water which leaves the other when the machine is revolving at the speed it is intended to work at, and we may further remark, that the turbine should be worked out of the tail-water.

Three of the four turbines represented in Professor Ruhlman's work are, in our opinion, quite unworthy of being made the subject of remark; the fourth is one of the two erected at St. Blasien, and, as it is not a bad machine in some respects, our observations have been made in reference to it more than to the others. As Sir Robert Kane has not informed us that the contrary is the case, we have taken it for granted that none of the other turbines referred to in his introduction have any decided superiority over those represented or described in Professor Ruhlman's work, and have made our observations accordingly. It should have been mentioned before, that the revolving part of the turbine above described should always be full of water, or nearly so, and we should also have stated that the effect or power of the machine will not depend much, if at all, on the water from the stationary part *striking* against the paddle-boards.

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## Art. II.—REPORT ON EXPLOSIONS IN COLLIERIES.

Having in conformity with the instructions contained in the Earl of Lincoln's letter of ths 27th of August, 1845, directed our attention to the composition of the gases evolved from coal beds, to the mode of ventilating collieries, and to the subject of explosions in them generally, we have the honour to submit the following statement for consideration :—

With respect to the gases evolved from beds of coal, they may be viewed as the result of the continued decomposition of the vegetable matter from which coal is derived, a decomposition which may be regarded as still in progress under favourable conditions. Omitting the mineral substances, which, when burnt, are known as ashes, coal is essentially composed of carbon, oxygen, hydrogen, and nitrogen; and the quality of the coal depends upon the relative proportion of these ingredients. When the proportion of the carbon to the oxygen and hydrogen does not exceed about 75 per cent. the coal, in common terms, is called "bituminous;" when the carbon amounts to about 85 or 90 per cent. it is termed "anthracite," or stone coal; or, in other words, the most advanced state of decomposition of the original vegetable matter bears the latter name.

During the decomposition a portion of the carbon is removed by its union with oxygen, forming carbonic acid, and another portion by combining with hydrogen, as carburetted hydrogen. Thus, by continued decomposition, the carbon gradually becomes a more important constituent in the remaining part of the original vegetable mass. The change from bituminous coal to anthracite can be produced artificially, and in a manner to illustrate the subject considered geologically.*

Though carbonic acid is, no doubt, found in many of our collieries in such a manner as to show it to be derived not only from the lights, horses, and workmen employed, but also to be partly the result of the progressive decomposition of the coal, it is with the carburetted hydrogen, or firedamp, as it is termed, that the collier has chiefly to contend. This comes upon him in various ways. Some coals more readily emit it than others, and hence they are locally termed fiery seams, beds, or veins. From some coals it would appear to escape more generally from the mass of the bed than from others, the gas gradually accumulating from the discharge over a wide surface. Other beds, again, are more fiery in the softer than the harder portions, and where joints or fissures are common. When two or more seams of coal, having different qualities, make up a workable bed, one will sometimes be more fiery than the other. Again, much depends, all other circumstances being equal, upon the kind of roof or covering rock of a coal-bed. If this be sufficiently porous, as many sandstones are, the conditions for the escape of the firedamp upwards through superincumbent rocks are more favourable than where the roof is composed of clay or argillaceous shell.

The dislocations of the strata termed "faults" or "troubles" act frequently also as channels for the passage of the firedamp into the works, as they conduct the gas from coal seams beneath, which may be highly charged with it, although the seam under work may be free.

Although we may regard a large proportion of this gas as previously formed, and ready to escape when the necessary conditions, such as those of colliery workings, present themselves, we can scarcely suppose that carburetted hydrogen is not also formed during the time occupied by the progress of the same workings, much being evolved from the older portions of them. The manner in which splinters of coal are thrown off during the cutting of some beds has led to the hypothesis that the gas may be present in a liquid state, produced by condensation, so that when the needful pressure is removed during the progress of the work, the sudden expansion of the "fire-damp" from a liquid to a gaseous form throws off the fragments. The force also with which the gas bursts suddenly forth from clefts or joints in some beds of coal is so considerable as to prove much previous compression, particularly when those bursts or blowers last only for a short time. When they continue for protracted periods, we may infer a more constant supply from continued decomposition of the coal, though the first sudden burst would point to compression. It has been inferred that the small cavities in which the fluid gas is confined can be detected by the microscope in some coals. It, is probable that soft places, the sides of joints and fissures, and the walls or faults, are more favourable to the decomposition of the coal than its more solid portions.

The escape of fire-damp is generally influenced by the barometrical state of the atmosphere, especially when much of the gas has become accumulated in the wastes or goafs. This is more or less experienced in all pits; but one striking case was pointed out to us by Mr. Jobling, of Jarrow Pit. In a pit of which he is the viewer the gas issues from cracks in the roof of the seam, and in low states of the barometer is evolved in considerable quantity. When the barometer is high, instead of this issue of gas, there is a sensible current of air which enters into the cracks. When this inward current takes place the pit is worked with naked candles, but when the evolution of fire-damp commences, Davy's lamps are employed.

Assailed in this manner by a gas which, when mingled with atmospheric air in certain proportions, is highly explosive, a knowledge of its exact composition becomes a subject of great importance to the collier, since effective precautionary measures, more especially as regards the lights employed, mnst necessarily depend upon such knowledge.

Dr. Henry, Sir Humphry Davy, in this country, and Bischoff and others on the continent, have examined into the nature of the explosive gasses of mines, but with results differing from each other; for while the English chemists found them to consist of carburetted hydrogen, with little or no admixture, the continental chemists have described them as very complex mixtures of olefiant gas, carburetted hydrogen, carbonic oxide, hydrogen, nitrogen, oxygen, and carbonic acid. On such a point ignorance would be culpable; and we were instructed to bring our knowledge up to the present advanced state of chymical analysis. Whilst we were engaged in this research, Professor Graham made a report to the Chymical Society on the same subject. The previous investigations of this chemist had rendered him well fitted for the task, and the results of his inquiries (according, as they do, with our own) amply guarantee that the subject, as far as relates to this country, may now be considered as decided, and show that the importance of an exact determination had simultaneously engaged the attention of the public.

It is unnecessary to describe in detail the methods which we pursued in the analysis; it may be sufficient to state that we adopted the methods mentioned in a report to the British Association on the analysis of gases by Professor Bunsen, and one of us. We may, therefore, at once tabulate our results, merely stating that we have devoted much attention to this investigation, so as to remove doubt upon a subject so important to the interests of the public. The gases were collected in various ways, some from blowers, others from the freshly exposed surfaces of the coal while the gas issued out with a singing noise, others from the explosive atmosphere of pits.

| Gases. | Wallsend, from Pipe on Surface. | Wallsend. Bensham Seam. | Jarrow. Bensham Seam. | Hebburn, Bensham Seam. 161 fathoms deep. | Jarrow, Low Main. | Jarrow. 5-4 Seam. | Gateshead, Oakwell Gate, 5-4 Seam. | Coal 24 feet below Bensham Seam, Hebburn Colliery. |
|---|---|---|---|---|---|---|---|---|
| Carburetted hydrogen | 92·8 | 77·5 | 83·1 | 86·0 | 79·7 | 93·4 | 98·2 | 92·7 |
| Nitrogen | 6·9 | 26·1 | 14·2 | 12·3 | 14·3 | 4·9 | 1·3 | 6·4 |
| Oxygen | 0·0 | 0·0 | 0·6 | 0·0 | 3·0 | 0·0 | 0·0 | 0·0 |
| Carbonic acid | 0·3 | 1·3 | 2·1 | 1·7 | 2·0 | 1·7 | 0·5 | 0·9 |
| Hydrogen | 0·0 | 0·0 | 0·0 | 0·0 | 3·0 | 0·0 | 0·0 | 0·0 |

The general result of this examination is, that the only inflammable constituent present in the explosive gas of collieries is carburetted hydrogen or fire-damp; there is not a trace of olefiant gas and only in one out of

* Specimens in illustration of this, made by cokeing coal in a very gradual manner, are deposited in the Museum of Economic Geology.

the eight gases analyzed is there hydrogen. It follows from the previous analysis that the issue of fire-damp into the atmosphere of a mine must deteriorate the air, by adding an undue proportion of nitrogen gas; in one case this gas amounts to 21 per cent. During an explosion the oxygen necessary to the respiration of the workers is removed by uniting with the carbon of the fire-damp, and thus producing carbonic acid, a gas most fatal to animal life. This carbonic acid, mixed with the residual nitrogen of the atmosphere, and that present in the explosive gas itself, forms what is termed after-damp, which produces effects more fatal even than those arising from the explosion. It often happens, that after an explosion a sufficient quantity of oxygen remains to support the respiration of those who survive its effects, were it not for the presence of carbonic acid. This gas when present in no greater proportion than one to two per cent., is capable of producing the most injurious effects. It has therefore been suggested, that cheap mixtures, made of substances capable of absorbing carbonic acid, such as glauber salts and lime, would prove useful to those who try to aid the sufferers after the explosion. Such a mixture placed in a coarse bag and applied to the mouth would effectually absorb the carbonic acid, and prevent it exercising an injurious effect on respiration. Certainly, the want of some such precaution in the case of the Jarrow explosion caused the death of a very meretorious man, Jacob Difty, the overman of the pit.

An explosion is however generally attended with much more complex results than those described as attending the combustion of carburetted hydrogen. The amount of fire-damp which may be first ignited may be trivial, and yet produce the most disastrous effects. From its lightness it accumulates at the upper part of the passages, and diffuses with considerable difficulty, often acting as a train, communicating the explosion to the pent-up reservoirs of gas in the goafs. It is thus that in almost all accounts of explosions two are generally described as taking place; the first local, and at the seat of the explosion; the second more general, and aided by any accumulation of foul gas in other parts of the pit. In the case of Jarrow, the heat attending the explosion was so intense as to have thoroughly coked to the depth of nearly one quarter of an inch the coal lining part of the walls of one of the passages; an effect which could scarcely be conceived without supposing that the flame played for some time upon it with the intensity of a blow-pipe flame. The surface of coal thus acted upon was so considerable that the amount of explosive gases evolved during this coking must have been far from insignificant, and may have aided the explosion itself. Add to this, that the first effect of the explosion is to blow up and ignite the immense quantity of coal dust lying about the pit, and not only produce from it an evolution of gas, but also occasion the production of much carbonic acid, and it cannot escape attention that the whole subject becomes involved in much complexity. It is known that a certain mixture of air with carburetted hydrogen prevents its ascendibility; and, in the case of pure carburetted hydrogen, the proportion has been ascertained to be not less than 15 times its own bulk. But the variation in composition of the fire-damp of different mines, the uncertain modes of its issue, and the absence of any ready means of ascertaining its quantity, prevent any general rule being given as to the amount of air which should be thrown into mines to prevent the atmosphere ever attaining the explosive state. All this must be determined by practice to suit the varying conditions of different mines. It is certain that improvements might be made on the rude methods now in use for effecting the necessary mixture. The fire-damp being, from its lightness, at the top, is not quickly influenced by the current of cold heavy air descending the down cast shaft, and circulating through the passages. It is therefore not unfrequent to see colliers flapping their jackets among this light gas, so as to dilute it with the sufficient quantity of air, and thus disturb the train of communicating gas which, in a foul state, may connect two dangerous parts of a pit. Mechanical contrivances, such as fanners, would more efficaciously produce the result than the inefficient extemporaneous means referred to; but, in general, such arrangements are only necessary when, from a defective ventilation, the current of air through the pit is not sufficiently strong.

Various artificial means had been proposed to facilitate the withdrawal of fire-damp from a pit. Suggestions have been made to take advantage of the lightness of the gas by favouring its ascent to the upper parts of the pits, and drawing it off by special air ways. Pipes let down into the wastes have been proposed for the same purpose, while other suggestions have been made of pipes to blow in air at the tops of the passages, so as to cause the dilution of the gas.

We do not stop to consider these plans, because, as we have already stated, the conditions under which coal is worked are so numerous, that a plan which might prove useful in one pit would be wholly inapplicable and sometimes positively injurious in another, and the legislative application of any one plan might prove highly prejudicial to this great branch of national industry.

In 1835, a Select Committee of the House of Commons was appointed to inquire "into the nature, cause, and extent of those lamentable catastrophes from explosions which have occurred in the mines of Great Britain, with the view of ascertaining and suggesting the means of preventing the recurrence of similar fatal accidents." Numerous witnesses were examined before this Committee, a body of important evidence collected, and a report published in the same year,—a report replete with valuable information, and to which we would wish to refer for ample details, connected with the general mode of working collieries, especially in the north of England. The Committee observe, on the subject of colliery explosions, that while the loss of interrupted trade by these accidents is enormous, "it is nevertheless rather with reference to the cause and interest of humanity than in a pecuniary point of view that this inquiry has assumed its great importance." This Committee did not recommend any remedial measures.

The difficulty experienced of obtaining accurate information respecting the number of lives lost from colliery explosions within a limited period is nearly as great at the present time as it was in 1835. And it should be borne in mind that of the number of lives lost by the great explosions, those which chiefly become known and arrest public attention, by no means afford a correct view of the collective loss of life sustained by colliery explosions generally, including the minor accidents not commonly heard of beyond limited districts; neither does it represent the injury sustained by these explosions, short of the loss of life, but from which many persons are more or less disabled.

The Committee were enabled to ascertain that during the 25 years preceding these inquiries 2,070 persons had perished from colliery explosions; and they considered this number much underrated. During the last 10 years the rate of loss of life from this cause has certainly not diminished. The experience of the past year has shewn that considerably more than 100 persons have been known to have thus perished.

It has so unfortunately happened that, during the few months we have been engaged upon this inquiry, two explosions, one at Jarrow in Durham, and the other at Risca in Monmouthshire, have together deprived 76 persons of their lives, 41 having perished at the former, and 35 at the latter.

By direction of Sir James Graham and the Earl of Lincoln, we were commissioned to ascertain the causes of both explosions. It so occurred that, being at that time in the south of Ireland, engaged on the duties of the geological survey, Sir Henry de la Beche could not reach Jarrow in time for the inquiry, and therefore the investigation into the cause of the explosion at that place devolved upon Dr. Playfair, who, under these circumstances, availed himself of the services of Mr. David Williams, at that time one of the geologists attached to the geological survey of Great Britain, and well skilled in coal mining, but now in the service of the East India Company, examining the coal resources of India. The results of this inquiry are given in the accompanying report by Dr. Playfair.

Immediately after the explosion at Risca on the 14th of January, 1846, instructions were again received to proceed without loss of time to that colliery. Dr. Playfair being, however, so engaged upon duties in London, that he could not readily proceed to Risca, the investigation was undertaken by Sir Henry De la Beche, aided by Mr. Warrington Smyth, mining geologist to the Geological Survey of the United Kingdom, who was in every respect qualified for such an inquiry. The accompanying report contains the results of this investigation.

During these inquiries it became very important carefully to consider the kinds of lights employed in collieries, and the usual regulations respecting them. The subject was not new to us, since for more than 25 years the mode of working collieries in different parts of the United Kingdom, as also on the continent of Europe, had engaged the attention of one of us. On the subject of safety lamps, of lighting generally, and of the regulations connected with it, the Committee of 1835 collected a large amount of evidence, more especially regarding our northern collieries. In the report of the South Shields Committee of 1843 there is also much information on this head. To these reports, therefore, we would wish to refer for sufficient information on the subject.

The Committee of 1835 pointed out that more persons had lost their lives from colliery explosions for the 18 years succeeding the introduction of the Davy safety lamp in 1816 than in the 18 years preceding the invention, and accounted for this fact by the working of numerous "fiery" seams of coal, which had, in consequence of the assumed security of that lamp, been undertaken, and by the abandonment of many precautions considered requisite when candles were commonly employed in collieries.

As much doubt has been thrown upon the real safety of the Davy lamp, it is but justice to the memory of Sir Humphrey Davy to state that he was perfectly aware that, if a proper mixture of fire-damp and common air were thrown against the lamp with sufficient force to project the flame upon the gauze cylinder, it might communicate with the flame, and cause explosion. Mr. Buddle, in his evidence (Report of Committee of 1835, Nos. 2,226 and 2,227), clearly shows this to have been the case. He mentions an experiment at Morton West Pit, where a very powerful blower from the shaft was tried with the lamp, when the flame passed and the blower was fired. Sir Humphrey Davy then, addressing Lord Durham, and many other persons who were present, said, "Now, gentlemen, you see the nature of the danger to which you are exposed in using the lamp, and I caution you to guard against it in the manner I have shown you. This is to show the only case in which the lamp will explode; and I caution and warn you not to use it in any such case when you can avoid it without nsing the shield." The shield recommended was one of tin, inside the cylinder, to prevent a current of fire-damp from acting on the flame. Mr. Buddle stated before the Committee that, in the lamps used in the collieries under his management, the shield passed from one-half to two-thirds round the inside of the cylinder, and, being bright, reflected the light to such an extent as to be more advantageous than a glass cylinder, inside that of wire gauze, a contrivance often recommended to obviate the risk of currents of fire-damp.

Dr. Pereira, at the request of the Committee of 1835, experimented upon many lamps before them, and passed the flame through all those tested, except that of Messrs. Upton and Roberts. The experiments have been repeated at the Museum of Economic Geology, by Dr. Pereira and by ourselves, with the ordinary Davy lamp, and with the same results.

There can, therefore, be very little doubt that the flame can pass, and explode fire-damp adjacent, if the current be sufficiently strong, and no protection be afforded either by a metallic shield or by an internal glass cylinder. The question as to the amount of current required seems not so well ascertained. Mr. Buddle considered that the blowers would rarely be found strong enough. Mr. Stephenson supposed that many accidents may have happened by the falling of the roof producing a sudden rush of explosive fire-damp. It will be obvious that the same effect might be produced by the careless swinging of the lamp with the required velocity through an explosive mixture of fire-damp and air, or from the lamp being so jerked out of a collier's hand, by an unlucky fall, that the cylinder presented the necessary front to the same compound.

Without desiring, in the slightest degree, to cast unnecessary doubt on the safety of the Davy lamp, since we consider its cautious use an immense boon to coal mining, and believe that much additional security is obtained by the proper use of the original Davy, or of its improvements, it can scarcely be denied that far more care in the use of safety lamps is needed than is commonly employed. Although shields or glass cylinders are used in some localities, they are never employed in others; and the bare single cylinder of wire gauze, not always properly manufactured, is the only form in which the Davy lamp is known. And it should be observed that, with a few local exceptions, the Davy lamp is that commonly employed. Numerous modifications, and, in some cases, improvements, of the safety lamp have been made, but, either from the expense, or want of simplicity in management, have never come generally into use.

The colliers, by their usual mode of carrying the common Davy lamp, certainly, under ordinary circumstances, guard against the passage of any current of fire-damp sufficiently strong to pass the flame, by placing the lamp within their jacket flaps, or carefully protected in some other manner. Abundant carelessness, is often, however, apparent; and, when the collieries are viewed as a whole, unnecessary risk is too common, especially when it is recollected that the foolhardiness or carelessness of one may destroy the lives of many.

To those who have, during many years, had occasion to visit collieries in different parts of Great Britain, the thoughtless daring of many of our colliers, and their frequent carelessness under danger, must be familiar. They will often, in an endeavour to execute more work in a given time, when paid by the ton or piece, remove the covers of their lamps, or employ a candle at a risk. Some even prefer a candle to ascertain the presence of fire-damp, since by it they more readily see the change in the flame. In many districts, though in some they are anxious to employ the safety lamp, it requires much trouble on the part of the managers to prevent the continual use of candles in suspected places before the danger becomes known to them. The less light afforded by lamps is considered a great drawback to their use when it can be avoided. Many most careful men, no doubt, anxiously watch over the common danger, and great precautions are taken by many coalowners and workers; but, looking at the subject generally, and without reference to many exceptions, especially to be found in the north of England, the want of system in the management of lights, and in due precautions respecting the kinds employed, can scarcely escape the observation of those whose opportunities have been sufficiently extended.

When we consider that the safety lamps have now been in use for so many years, causing security in all cases where proper care is employed, although they may not be absolutely safe under unusual circumstances, their utility appears sufficiently sanctioned by experience to make them the subject of legislative enactment. The evils complained of in the modifications of the Davy lamp are, that, while they add to the security, they diminish so much the amount of light, as to render them practically useless. These are described in the Report of the Select Committee referred to. A new modification of Dr. Clanny's lamp, invented since then, is not subject to this fault, and in principle is an elegant application of the safety lamp, and consists of a wire-gauze cylinder, having beneath a thick glass cover to the lamp, which only ascends till it meets with the gauze; the thickness of this glass is supposed to free it from accidents, and whilst strong enough to bear a considerable blow, it is sufficiently well annealed to resist sudden changes of temperature. But whether, in a manufacture so uncertain as glass, these conditions can always be attained, is questionable, and at all events has not been sufficiently tested by experience to induce the coalowners to employ this lamp in their mines.

It has been at various times proposed, during the last eight years, to employ electricity as a means of lighting collieries. The electricity, streaming between two charcoal points from a Grove's or a Bunsen's battery, affords a light of much beauty, and perfectly safe, if completely surrounded by glass, but capable of igniting an explosive mixture if exposed. Professor Grove has constructed a lamp on this principle, which he kindly prepared for us, and which we have examined in action. It consisted of a box, containing four galvanic cells, and the light was obtained by the passage of electricity between two coils of platinum wire. These were surrounded with glass vessels; the inner one for the purpose of isolation, the exterior one being filled with water, so as to destroy the light should the inner glass vessel be broken. The light given out was rather more than that of a miner's candle. This, certainly, is a safe lamp, but in its present state still unfitted for the purpose of the collier as at present arranged. The acids, sulphuric and nitric, render the lamp so inconveniently heavy, that both hands must be used in carrying it; besides, from not being covered, the spilling of these corrosive liquids on the persons of the miners could scarcely be avoided. The water in the exterior vessel soon becomes heated, and ultimately boils, and the light only lasts in proper strength for two or three hours. There must, therefore, be considerable modification in this lamp before it can be rendered available for ordinary mining purposes, which we may readily expect, from the acknowledged talent of its inventor.

The means of obtaining the needful lights in collieries, though most important, would still appear subordinate, as has, indeed, been before remarked, to such a system of ventilation as should not expose men in such large portions of a colliery as is now frequently the case to the risk of death from explosion (the greater proportion, and often all perishing from the carelessness of one man), or to unforeseen accidents under the greatest precautions in the use of lights. The too common use of single shafts in collieries, in cases where others might have been sunk, the single shaft divided into two or three portions by wooden partitions named brattices, a down current of pure air descending through one division, and the foul air from the colliery workings rising up through another, has often been reprobated. The committee of the House of Commons of 1835, and many important witnesses examined, animadvert upon this practice; and the bad effects of this system is pointed out by the South Shields Committee in their report of 1843.

In a single shaft, as has been often remarked, the ventilation may be cut off from the workings of a whole colliery in an instant by an explosion sufficient to destroy the doors or partitions directing the air-courses, the air merely going down one division in the shaft and rising through another, when the brattices may not be destroyed by the explosion, and a kind of draught kept up. Thus all not destroyed by the explosion perish in the mixture of nitrogen and carbonic acid, known as after-damp, to which no fresh air can reach. In the explosion at Jarrow Colliery there was only a single shaft communicating with the workings upon two beds of coal one above the other, and the lower part of the brattice in the shaft was so shattered by the late explosion in it, that Dr. Playfair and Mr. Williams, in their descent into the pit, then containing a large amount of the fire-damp, had to be let down a considerable distance by a loop in a rope. In this explosion the upper portion of the brattice fortunately remained, and thus the lives of many of those engaged in the upper workings were saved, although several perished.

Even in a double shaft, or two shafts not far distant from each other, if the air be not made to course for a considerable distance amid the workings by a firm thick parting of coal, any needful perforation in the parting for the progress of the colliery being firmly built up, a whole mass of workings may, by an explosion, be suddely cut off from ventilation, and numbers of persons, not killed by the explosion, perish by the after-damp. This was the case at the late explosion at Risca. It should, however, in this instance be observed, that the colliery was, as regards ventilation, in a transition state, a more perfect arrangement for ventilation being in progress.

Great improvements were introduced in the ventilation of collieries in many districts, when the course of air was quickened by means of a furnace established near the bottom of the upcast shaft, or that through which the foul air passes outwards, and more particularly when, in the north of England, instead of permitting the air introduced by the downcast shaft to pass slowly and imperfectly along a course of 20 or 30 miles of passages, it was split or divided into separate courses, from two to six miles in length. Those, however, who may possess an extended acquaintance with our collieries in different parts of the country cannot but be aware, that as a whole, their general ventilation is very imperfect, good as it may be in some collieries, particularly in certain districts.

When it is considered that coals are worked in the United Kingdom under every variety of condition,—from levels driven into mountain sides to pits sunk to great depths through masses of superincumbent rocks,—in beds ranging from a vertical to a horizontal position, and even contorted and bent,—sometimes traversed by faults, at others free from them,—the beds near the surface in one place, and ranging beneath mountains in another,—in fact, under a great variety of geological conditions, it is not difficult to see that many plans which have been suggested for the working of collieries, good as they may be for some localities, would be inapplicable generally, and would indeed fail, except under the conditions fitted for them.

So various are the conditions under which collieries are or can be worked in the United Kingdom, that we would suggest for consideration, if legislative measures should be deemed advisable, and an extension of the principle which regulates the employment of women and children in our mines, and the labour in our factories, be thought good, that effective discretionary powers should be vested in properly qualified persons, appointed in convenient districts, so that the needful adjustments to conditions may be effected, and no single system be attempted inapplicable to our collieries as a whole.

Any general system of legislation for conditions so different could only be productive of failure or of injurious consequences, both to owners and workers; but a local examination and inquiry, with power to adjust to special conditions, would, we apprehend, remove the difficulties which the Legislature has felt in dealing with interests so important.

Jealous as the coalowners should properly be of any undue intermeddling with their collieries, it may nevertheless be true that a judicious system of superintendence in a district, by which the proper ventilation of collieries, efficient knowledge on the part of subordinate agents, and proper punishment for foolhardiness or carelessness on the part of the colliers may be secured, would be a great advantage to them individually and collectively, and be the saving not only of lives but of much capital, securing them, in the case of accidents, from many an unjust accusation for neglect.

On the other hand, careful but not overmeddling supervision would afford confidence to the collier. Proper persons being appointed as superintendents (and, if improper, their deficiencies would soon become apparent, and their removal the consequence), he would feel that he has the advantage of the existing knowledge of the day brought to bear upon the particular conditions under which the colliery in which he labours is worked. In some districts the working collier is far better informed upon the general principles which should receive attention than may be commonly supposed, and he would feel far more secure from danger than he now does, if assured that the State was not neglectful of his safety.

Though several collieries in particular districts possess good plans and sections of their workings, and an inspection of such plans and sections affords a view of the system of ventilation and general mode of working adopted, this is far from being the case generally, and has been much regretted alike by the enlightened coalowners and by the public. The importance of correct plans and sections has been prominently pointed out, both by the Committee of the House of Commons of 1835, and in the report of the South Shields Committee of 1843; indeed, the necessity of them is sufficiently obvious.

Should the suggestion of a system of judicious inspection be considered worthy of consideration, the ready access to proper plans and sections of collieries, brought up to given times, would necessarily form a part of any general system of regulations. If correct (and power to ascertain that they were so would be essential), they would at once disclose the system of working and ventilation adopted, and, with information respecting the police regulations, and an account of the kind of lights employed, would at once afford a general view of the mode of conducting any particular colliery, and of the adjustment of the workings to conditions.

It being considered that safety lamps, properly used, do effect much security in the working of coal, and that in so many cases explosions do take place when they are not employed, it has often been suggested that the Legislature should compel the general use of safety lamps in coal mines. But, on the other hand, there are many collieries in which fire-damp never appears, and it would justly be considered a hardship in such cases to compel a precaution altogether unnecessary.

We would suggest that it could not be considered unjust for the Legislature to compel the use of safety lamps in all fiery collieries; and, in the present state of the law of property, it might even be prudent to assume that all collieries in districts where explosions have been frequent are fiery, putting the *onus probandi* that they are not, upon the owners of such collieries. If proved to the satisfaction of the inspectors that no reasonable danger was to be apprehended in their collieries, license might be given for them to work with naked candles, this license ceasing at short periods, but being renewable on ascertaining that the conditions of the mine had not altered.

Careful investigations into the causes of explosions in collieries, only part of which arrest public attention by their magnitude, appear to have led to the very general conclusion that the condition of our collieries is most unequal. While in some localities there is so little to improve that it becomes a subject of regret that such examples should not more generally be followed, in others it becomes a matter of surprise how the works can be permitted to remain in so defective a state, seeing that the owners themselves suffer much loss thereby. Under such a state of things, and considering the number of valuable lives annually lost by colliery explosions, the continued risk to which so many are daily exposed, the national injury sustained by the imprudent and careless mode of extracting coal in many localities—one often felt oppressively also by the parties engaged in colliery speculations—and that the workings for coal must be adjusted to local conditions, we are led to consider that these evils might be at least mitigated by the careful and judicious inspection of convenient districts by competent persons, the necessary funds to be raised from such districts by a very slight impost, not even exceeding one farthing on each ton of coal raised in it; and we believe that the cause of humanity and the interests of the coalowners would be alike benefitted by a well-considered legislative measure of this kind.

We have, &c.,

H. T. de la Beche.

Lyon Playfair.

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## Art. III—REMARKS ON LAND BEAM ENGINES.

The depth of the beam of a land engine at the centre is usually equal to the diameter of the cylinder: depth at ends one-third of depth of beam at centre; thickness of web 1-108th of the length; length three times the length of the stroke; breadth of edge-bead about $1\frac{1}{2}$ times the thickness of the web. The diameter of the end studs of the beam is generally made about 1-9th of the diameter of the cylinder when the studs are of cast-iron, and 1-10th of the diameter of the cylinder when they are of wrought-iron; but the larger proportion is preferable, as the wear of the brasses is then less rapid. It is a common fault to make bearings too small, from their proportionment being viewed with reference only to strength, whereas it should also be viewed with reference to wear.

The sectional area of the main links is usually made about 1-113th of the area of the piston, that of the piston-rod being 1-100th. To find the proper sectional area of the main links, a common rule is to divide the square of the diameter of the cylinder by 144. The length of the main links is usually about the same as the length of the crank, which is half the stroke. The main beam is always somewhat longer than the distance between the cylinder and crank centres, and at the cylinder end the perpendicular centre line divides the versed sine equally. The angular motion of the beam is about 38 degrees during the whole stroke. The length of stroke is the chord of the arc the centre of the end pin describes, and the versed sine represents the amount of deviation from the perdendicular which is called the vibration of the beam. The beam being three times the length of the stroke, the distance from the main centre to the end stud is one and a half times the length of the stroke, and with these proportions the end stud will deviate from the perpendicular one inch for every foot of stroke. To find the amount of vibration of the end stud:—from the square of the radius in inches described by the stud, subtract the square of the length of the crank in inches; extract the square root of the remainder, which deduct from the radius in inches. To find the proper distance between the main centre and the centre of the cylinder:—add the abovementioned square root to the radius of the lever in inches; half their sum will be the horizontal distance in inches.

The main centre of a land engine beam is usually fixed in with keys: the other centres are sometimes fixed with keys, and at other times they are ground in, which appears to be the preferable practice. The beam is set upon its edge, on two blocks of wood: a straight edge is applied to ascertain if it is nearly straight, and if bent or twisted it is brought straight by being hammered with the face of the hammer, though this practice weakens the beam if carried far. A cross piece of wood is put into each main-centre hole, upon which the central point is marked: the beam is plumbed, the end centres are put through, staked with wedges, and levelled by means of a short level with two legs passing down from the edge of the beam. The lengths from the main centre are next ascertained to be right, and the main centre is then put in, using the end centres as points to measure from. Finally, the keys are fitted. This is the mode of procedure when the holes for the centres are not bored out. It is expedient to put a centre line on the edge of the beam to fix the position of the studs laterally, and this is generally done. The force acting at each end of an engine-beam may be taken at 14lbs. per circular inch of the piston, or, if the beam be supposed to be supported at both ends, it may be taken at 28lbs. per circular inch acting at the centre. The depth of the beam at the ends being one third of the depth in the middle, to find the dimensions at the middle, divide the weight in pounds acting at the centre by 250, and multiply the quotient by the distance in feet between the supports. To find the depth, the breadth being given:—divide this product by the breadth in inches, and extract the square root of the quotient, which is the depth. It is expedient, however, to make main beams stronger than is indicated by any of these rules, as a higher pressure of steam is now used almost universally than was employed by Mr. Watt.

The sectional area of the back links is made the same as that of the air-pump rod, which is one-tenth of the diameter of the air-pump, or one-twentieth of the diameter of the cylinder. The sectional area, therefore, of the two back links taken together is equal to the area of a circle one-twentieth of the diameter of the cylinder; but in practice they are generally made of somewhat stronger proportions.

The best proportionment of the parallel motions of land engines, and that now followed universally, consists in making the radius and parallel rods of exactly the same length, and this length equal to half the radius of the great beam. The stud from which the back links are hung is in this case situated midway between the main centre and the end stud of the beam, and the studs in the spring beams round which the radius bars move, are in the same vertical line as the centre of the cylinder. To find, therefore, the right position for those studs, measure down perpendicularly from the centre of the end stud, when the beam is level, to a distance equal to the length of the main or back links, and at this distance draw a horizontal line on the inner sides of the spring beams. Then set off from the main centre on this line the distance between the main centre and centre of the cylinder: the point of intersection is the right position of the studs in the spring beams to which the radius or bridle rods are attached. In Mr. Watt's early engines the radius rods were made longer than the parallel rods, and were attached to a shaft which passed across between the spring beams clear of the end of the working beam; but the universal practice now is to introduce studs into the spring beams, whereby the parallel and radius bars may be made of the same length. and this is in every way a preferable arrangement.

The back links and the main links are always of the same length, and their length was, according to Mr. Watt's practice, three-sevenths of the stroke, but they are now generally made half the length of the stroke, or the length of the crank, as we have already stated. The air-pump cross head is inserted in the back links at the middle of their length. The point in the back links moves, it is obvious, in the vertical line, for as the top of the links follows the motion of the main beam, and the bottom that of the radius bars, which have the same radius and the same length of motion as the stud in the beam from which the links are suspended, the central point of the links will have motion in a curve equally removed from that of each end, which will be a straight line very nearly. The line traced by the parallel motion is not precisely a straight line, but a species of S curve; it approaches to a straight line, however, with sufficient nearness for every practical purpose. Notwithstanding the elegance of the parallel motion, as an expedient for maintaining the perpendicular position of the piston-rod, it is questionable whether guides are not to be preferred. In America they are very generally used, even with very long strokes and very short beams; and in some of the steam vessels in this country they have been substituted with advantage. The adjustment of parallel motions is a difficult task in the hands of ignorant persons; and unless the parallel motion be very true it will be difficult to keep good packing in the stuffing-box, and the cylinder will speedily be worn oval. If guides be used, it appears to us expedient that they should consist of strong round rods, and that the eyes at the ends of the cylinder cross-head should be formed into stuffing-boxes, which may be tightened up when the holes wear. The ends of the rods must rest in sockets cast on the cylinder, and the cylinder cover should not be made tight with gasket, which may be compressed more in one part than in another, but should be formed with a metallic joint. If a parallel motion, however, be preferred to the guides, we should suggest its being made in fewer pieces. We see no use whatever in making the main or back links to consist of pillars and straps. Engineers have become wedded to this species of architecture, and the combination is satisfactory to their associations, but unbiassed judges, we humbly conceive, would prefer suitable pieces of solid iron, with holes and brasses in the right places. If guide-rods be used, however, such as we have suggested, it will be necessary to make the lower portions of the main links with straps and cutters, as in the connecting-rod of a marine engine; as the stuffing-boxes at the ends of the cross-head, for the reception of the guide-rods, could not be passed through holes in the links.

Malleable iron connecting rods are now coming into use for land engines, and they are in every way preferable to those of cast-iron. When the connecting-rod is of cast-iron, of the form usually employed, the breadth across the arms of the cross is made about 1-20th of the length of the rod; the sectional area at centre of rod 1-28th of the area of the cylinder, and the sectional area at ends of rod 1-35th of the area of the cylinder. The length of the connecting-rod is generally made about three times the length of the stroke. The diameter of the crank pin is about one sixth of the diameter of the cylinder, and is generally made of cast-iron in land engines. The gudgeons of water wheels are generally loaded with about 500 lbs. for every circular inch of their transverse section, which is nearly the proportion which obtains in the end studs of engine-beams, but the main centre is usually loaded beyond this proportion. To find the proper size of a cast-iron gudgeon adapted to sustain a given weight, multiply the weight in pounds by the intended length of bearing expressed in terms of the diameter, divide the product by 500, and extract the square root of the quotient, which is the diameter in inches. For malleable iron the operation is the same, but the divisor may be made 1000 instead of 500. These strengths are not intended to resist torsion, but are those proper for gudgeons. Experiments upon the force requisite to twist off cast-iron necks show, that if the cube of the diameter of the neck in inches be multiplied by 880, the product will be the force of torsion in pounds which will twist them off when acting at six inches radius. The strength for cast-iron crank shafts may be determined by multiplying the square of the diameter of the cylinder in inches by the length of the stroke in feet, multiplying by the decimal . 15, and extracting the cube root of the product, which is the proper diameter of the shaft-neck in inches. This rule has reference not merely to torsion, but also to the strength as a gudgeon necessary to sustain the fly-wheel.

As regards fly-wheels, Messrs. Fenton and Murray use the following rule for determining the weight of the fly-wheel, which is simpler perhaps than those usually given:—Multiply the number of horses power of the engine by 2000, and divide the product by the square of the velocity of the circumference of the fly-wheel in feet per second: the quotient is the proper weight of the fly-wheel in hundred weights. To find the weight of the rim of a fly-wheel in pounds, multiply the mean diameter of the rim in feet by the area of its transverse section in square inches, and multiply the product by 9·817 lbs. This gives the weight of the rim in pounds when the sectional area is determined. Mr. Farey gives the following rule for determining the proper quantity of cast-iron in a fly-wheel in cubic feet:—Multiply the mean diameter of the rim by the number of its revolutions per minute, and square the product for a divisor; divide the number of horse power exerted by the engine by the number of strokes the piston makes per minute; multiply the quotient by the constant number 2,760,000, and divide the product by the divisor found as above. The quotient is the requisite quantity of cast-iron in cubic feet to form the fly-wheel rim.

In large engines each arm is cast separate, and after having been fitted to the central boss, the rim of the wheel is fitted to the arms in segments. In small engines, an arm and a segment are generally cast together. In mill engines it appears expedient to work with a short stroke and rapid piston, whereby the fly-wheel is made more effectual, or a smaller one will suffice. Combined oscillating engines, working with a high speed, will probably come into extensive use for turning mills; and if the arrangements be judiciously made, the fly-wheel may in time be dispensed with altogether.

We do not approve of the plan of putting cast-iron cranks on hot, as the eye is liable to be cracked in the process; it is preferable, we conceive, to grind them upon the shaft, and then to fix them by means of a strong square key. In cranks which are put on hot, it is expedient to recess the crank eye a little, so as to enable the collar upon the shaft to enter it, as the crank contracts sideways in the act of cooling; and unless the collar be recessed, a space will be left between it and the crank eye, which will be a disfigurement. The crank pin, is generally made slightly taper, and is fixed in by means of a key.

As nearly all rotative land engines give motion to mill-work, we shall here give some rules for proportioning the teeth of wheels. The diameters of toothed wheels should always be such as to enable a number of teeth to be in action at the same time; and pinions should not have less than thirty or forty teeth to enable them to work satisfactorily. Bevelled wheels act better than spur wheels, and wheels with internal teeth better than either; for the more nearly the lines of motion approximate, with the less velocity and shock will the teeth come together. Wheels are usually made with one tooth more or less than a number that will divide the teeth of each equally: this tooth is called a "hunting cog," and its effect is to bring every tooth of the one wheel successively in contact with every tooth of the other. In speeds above 220 feet in the minute, wooden teeth should be introduced in the larger wheel, and these teeth should be a little thicker than the iron teeth, to make them of equal strength. To find the proper dimensions of the teeth of a cast-iron wheel which is required to transmit a given power, Mr. Farey proposes to multiply the diameter of the pitch circle in feet by the number of revolutions to be made per minute, and reserve the product for a divisor. Multiply the number of horse power to be transmitted, by 240, and divide the product by the above divisor: the quotient is the strength. If the pitch be given, to find the breadth, divide the above strength by the square of the pitch in inches; or if the breadth be given, then to find the pitch, divide the strength by the breadth in inches, and extract the square root of the quotient, which is the proper pitch for the teeth in inches. Mr. Hick gives the following rule for computing the power that the teeth of wheels are capable of transmitting:—Multiply one fourth of the square of the pitch in inches by the breadth of the teeth in inches: the product is the number of horse power that the teeth will transmit when the pitch line passes through four feet per second. The length of the teeth or their projection from the rim of the wheel, is usually about five-eighths of the pitch. The breadth of teeth varies from one and a half to four times the pitch, the greatest breadth being made where there is the greatest liability to wear. If only one pair of teeth be supposed to be in contact, the force transmitted by teeth in average cases may be taken at 550 lbs. for each square inch of surface in contact. In several recent instances wheels have been made in steps, or a wide wheel has been compounded of several narrow wheels set in contact on the same shaft, but the teeth of each slightly in advance of those next succeeding, so that the pitch is divided, and the necessary strength is reconciled with what is virtually a fine pitch.

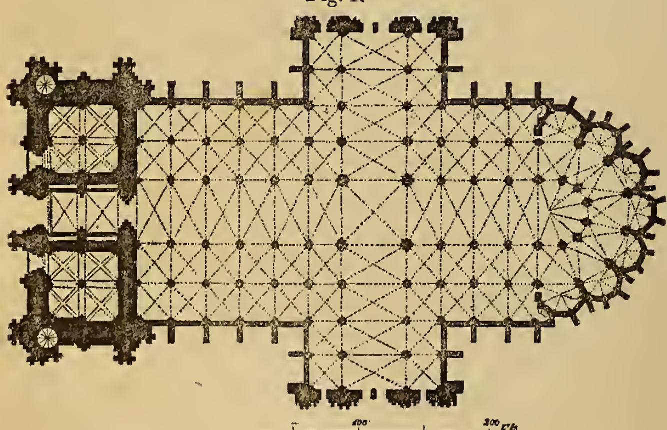
If a cubic inch of water be supposed to produce a cubic foot of steam, and the latent heat of steam at 212° be taken, with Mr. Watt, at 960°, or, in other words, the cubic foot of steam be supposed to contain so much heat in the latent form as would raise the temperature of the cubic inch of water, if it could be prevented from expanding, 960°, then the sum of the latent and sensible heats will be represented by 1172°. The temperature of the water discharged by the air-pump is about 100°, which, taken from 1172°, leaves 1072°, which must be taken up by such a quantity of cold water that its temperature will not rise above 100°. If the temperature of the injection water be 50°, then the difference between that and 100°, viz. 50°, is available for the absorption of the heat; and 1072 divided by 50 = 21·44, which is the number of times the quantity of injection water must exceed the quantity of water in the steam. To condense a cubic inch of water therefore in the shape of steam, 21·44 cubic inches of injection water are necessary; but inasmuch as the water may not always be as cold as 50°, Mr. Watt's practice was to allow a wine pint, or 28·9 cubic inches of injection water for every cubic inch of water converted into steam. The capacity of the cold-water pump is usually made from one thirty-sixth to one forty-eighth of the capacity of the cylinder. The injection orifice should have an area of about one fifteenth of a square inch per horse power. The capacity of the hot-water pump should be about one 240th of that of the cylinder, supposing that the engine is double-acting, and the pump single-acting. The air-pump is usually made half the diameter of the cylinder, and half the stroke, or one-eighth of the capacity. The power requisite to work the air-pump is from one-thirtieth to one-fortieth of the power of the engine. The openings through the foot and delivery valves are made of about one-fourth of the area of the pump. The internal diameter of the steam-pipe may be found by dividing the horse power by ·8, and extracting the square root of the quotient. This is all we have at present to say on the subject of Land Engines.

## Art IV.—THE CONTINENTAL CATHEDRALS.

The cathedral of Cologne is steadily advancing towards completion, and as the present rate of progress the structure will, it is computed, be entirely finished in twenty-five years. The work of restoration has created much enthusiasm in Germany: the workmen have fully entered into the spirit of the work, and if cathedral building were the rage of the present day, there is very little doubt that from such beginnings it could speedily be carried to a perfection unknown to the old freemasons, both in the scientific and artistic qualities of the work. This, however, is the railway age, and there is but little chance that any such combination of circumstances as led to the erection of the magnificent Christian temples bequeathed to us by the middle ages will speedily arise. Those structures, however, have latterly created a degree of interest unknown to the Augustan age of taste, and the completion of the cathedral of Cologne, after having remained in an unfinished and most imperfect state for several centuries, is both an effect and a cause of this wide regeneration. We here propose to lay before our readers some sketches by Mr. Gwilt, of a few of the most remarkable of the continental cathedrals, with some of his remarks respecting them, which he has given in his *Encyclopœdia of Architecture.* We shall begin with the cathedral of Cologne.

"A church had been erected on the present site of the cathedral of Cologne in the time of Charlemagne. This was destroyed by 1248, at which time Conrad filled the archiepiscopal throne of the city. Before fire had destroyed the former cathedral, this prelate had resolved on the erection of a new church, so that in the year following the destruction of the old edifice, measures had been so far taken, that the first stone of the new fabric was laid with great solemnity on the 14th of August, being the eve of the Assumption of the Blessed Virgin. Collections were made throughout Europe for carrying on the works, and the wealth of Cologne itself seems to have favoured the hope that its founder had expressed of their continuation.

Fig. 1.



CATHEDRAL OF COLOGNE.
Ground Plan.

The misfortunes of the times soon, however, began to banish the flattering expectation, that the works would be continued to the completion of the building. Gerard, who was the architect of the works in 1257, suffered the grief of seeing the archbishops of Cologne dissipate their treasures in unprofitable wars, and ultimately abandoning the city altogether for a residence at Bonn. The works do not, however, appear to have been interrupted, though they proceeded but slowly. On the 27th of September, in the year 1322, seventy-four years after the first stone had been laid, the choir was consecrated. The works were not long continued with activity, for about 1370, the zeal of the faithful was very much damped by finding that great abuses had crept into the disposal of the funds. The nave and southern tower continued rising, though slowly. Under Thierry de Moers in 1437, the latter had been raised to the third story, and the bells were moved to it. In the beginning of the 16th century, the nave was brought up to the height of the capitals of the aisles, and the vaulting of the north aisle was commenced; the northern tower was carried on to the corresponding height; and every thing seemed to indicate a steady prosecution of

Fig. 2.

CATHEDRAL OF COLOGNE.
Side Elevation.

the work, though the age was fast approaching in which the style was to be forgotten. The windows in the north aisle were decorated, though not in strict accordance with the style, yet with some of the finest specimens of painted glass that Europe can boast, a work executed under the patronage of the archbishop Hermann of Hesse, of the chapter, of the city, and of many noble families who are, by their armorial bearings, recorded in these windows. But with this the progress stopped. The works which remain are at once a monument of the genius which conceived such an edifice, and of the civil discords that prevented its completion. Our second figure exhibits the south elevation of the cathedral, in which the darker lines show the parts actually executed, and the lighter ones those which remain, alas! still to be developed in matter. If the reader reflect on the dimensions of this church, whose length is upwards of 500 feet, and width with the aisles 280 feet; the length of whose transepts was 290 feet and more; that the roofs are more than 200 feet high, and the towers when finished would have been more than 500 feet on bases 100 feet wide; he may easily imagine, that, notwithstanding all the industry and activity of a very large number of workmen, the works of a structure planned on so gigantic a scale could not proceed otherwise than slowly, especially as the stone is all wrought. The stone of which it is built is from two places on the Rhine, Koenigswinter and Unckel-Bruch, opposite the Seven Mountains, from both of which the transport was facilitated by the water carriage afforded by the Rhine. The foundations of the southern tower are known to be laid, at least, 44 feet below the surface."

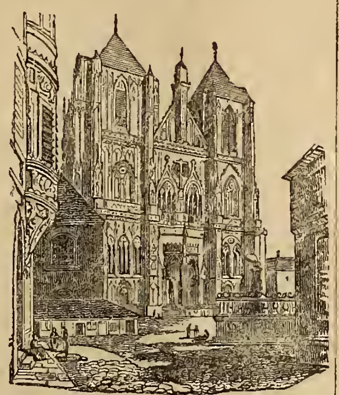
"The cathedral at Ulm (*fig.* 3.) is one of the many celebrated cathedrals of Germany: it was commenced in 1377, and finished, the tower excepted, in 1478. It is reputed to be the longest church in Germany, being 416 ft. long, 166 ft. wide, and, including the thickness of the vaulting, 141 ft. high. The piety of the citizens of Ulm moved them to the erection of this structure, towards which they would not accept any contribution from foreign princes or cities; neither would they accept any remission of taxes nor indulgences from the pope. The whole height of the tower, had it been finished according to the original design (still in existence), would have been 491 feet. It does not preserve the regularity of form for which the cathedral at Cologne is conspicuous, but the composition of it, as a whole, is exceedingly beautiful. At Ratisbon is another beautiful work, of about the same period, of which *fig.* 4, is a sketch; but we do not think it necessary to detain the reader with the description of it. At Vienna the cathedral of St. Stephen's exhibits another exquisite example of the style.

We have mentioned a few of the churches of France in the Byzantine or Romanesque styles. In the thirteenth century the pointed style there reached its highest excellence. "Every thing," observes Whittington, "seemed to conspire, in the circumstances of the nation and of the world, to produce an interval favourable for the cultivation of the arts; and genius and talents were not wanting to make use of the happy opportunity. The thirteenth century found the French artists, a numerous and protected body,

Fig. 3.

ULM CATHEDRAL.

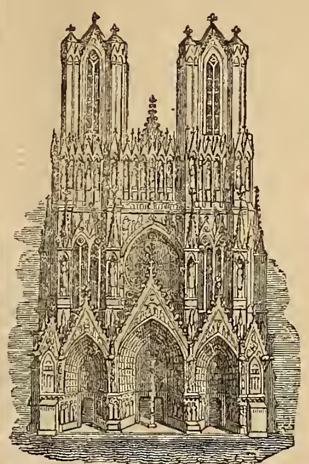
Fig. 4.



RATISBON CATHEDRAL.

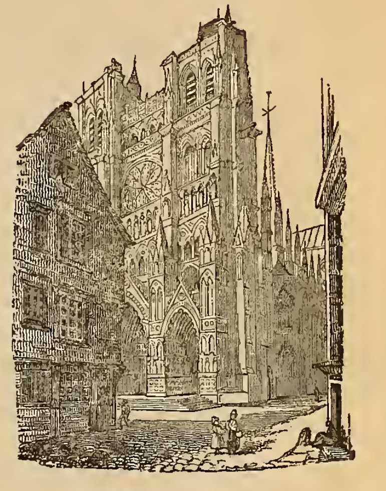
in possession of a new and beautiful style of building; the religious enthusiasm of the times, fanned by the spirit of the Crusades, was at its height, and the throne of France was filled by monarchs equally distinguished by their piety and magnificence." The chronicle of the abbey of Bec in Normandy informs us that Ingelramme, who had been employed on the church of Notre Dame at Rouen, was, in 1212, engaged on the church of this Norman abbey, a great portion whereof he raised in a year and a half, and in which he was succeeded by Waultier de Meulan, who finished the work in less than three years. Little of this building remains, from the circumstance of its having been burnt twice within the century, and renewed in its present form about 1273, by the Abbot de Caniba. At this period the churches of France were rising in every direction. At Rheims, the cathedral (*fig.* 5.) exhibited the elegant lightness of the new style; the body of the cathedral at Lyons was completed; the exquisite cathedral of Amiens (*fig.* 6.) was raised by Robert de Luzarches and his successors; and, among many other architectural beauties, the Sainte Chapelle of the palace at Paris. Neither must we omit the celebrated Eudes de Montreuil, among whose numerous works, after his return from the East, whither he had accompanied St. Louis, was the church of Notre Dame de Mantes, the boldness of whose vaulting astonished Soufflot and Gabriel in their scientific survey of the French churches, and of which it is related, perhaps fabulously, that when the building was finished, the workmen refused to remove the centering, until Eudes, by sending his nephew to assist them, quieted their apprehensions. The height of the vaulting from the pavement is 96 feet. This Eudes died in 1289, and of his two wives, Mahault, or Maud, attended the queen on her voyage to Egypt and the Holy Land. Another artist, Jousalin de Courvault, is known to have accompanied the king, (St. Louis) to

Fig. 5.



RHEIMS CATHEDRAL.

Fig. 6.

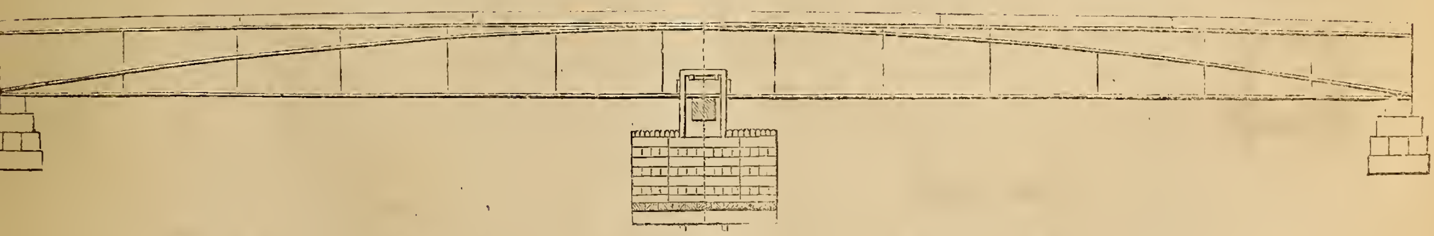


AMIENS CATHEDRAL.

the crusade. The number of ecclesiastical structures in France erected during the reign of St. Louis exceeds all former and subsequent example Besides a great number founded by individuals, the church and abbey of St. Antoine near Paris, those of the Filles Dieu, the Jacobins, the Carmelites, and the Cordeliers du Faubourg St. Marcel, were built by command of the king; and out of the metropolis, the abbeys of Lis, near Melun, of Longchamp near St. Cloud, and St. Mathieu, near Rouen; the greater part of the abbey of St. Denis; the Hotels Dieu of Vernon, Pontoise, and Compiegne; the church and abbey of Maubuisson; the church of the nuns of Poissy, and the monastery and church of Royaumont by Pierre de Montereau, are recorded as the monuments of this munificent sovereign. At the latter end of the twelfth, or in the beginning of the thirteenth, century, moreover, sprung up a brotherhood, known by the name of the *Confraternité des Ponts,* founded by St. Benezet, to which belongs the honour of having erected a bridge across the Rhone at Lyons, in 1244, and the Pont St. Esprit, another vast structure. The first stone of this was laid with great ceremony in 1265 by Jean de Tianges, prior of the monastery of St. Esprit, and the whole structure, above 3000 feet in length, was completed in 1309 The building of bridges and maintaining of roads at this period may be almost deemed to have been as great an act of piety as the founding of churches; and a religious association for such a purpose affords a proof of the previous barbarism and increasing civilisation of the age."

## Art. V.—STEPHENSON'S IRON BRIDGE OVER THE MENAI STRAITS.

Fig. 1.



EXPERIMENTAL MODEL OF STEPHENSON'S TUBULAR IRON BRIDGE FOR THE MENAI STRAIT, ONE SIXTH OF THE ACTUAL SIZE.

Elevation,

Scale 1 inch = $10\frac{1}{2}$ feet.

In a former number we gave a report by Mr. Stephenson, addressed to the directors of the Chester and Holyhead Railway, setting forth the practicability of carrying that railway over the Menai Strait, by means of a tubular bridge formed of iron plates rivetted together, through the centre of which the trains would pass. Numerous experiments have been made by Mr. Fairbairn and Mr. Eaton Hodgkinson with the view of ascertaining the best form of bridge for such a purpose; and a hollow beam of a rectangular section, and stiffened at the top to resist compression, has at length been fixed upon as the most suitable. A model of the intended bridge one sixth of the real size has recently been subjected to experiment at Mr. Fairbairn's factory at Millwall. This model, which we have just inspected, is accurately represented by the accompanying figures, and we shall have set down the more prominent of the results which the experiments evolved.

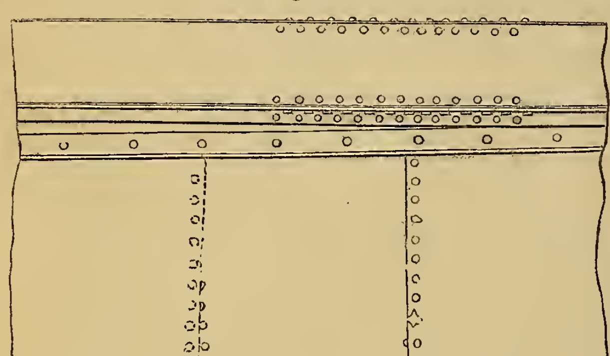
The model rests at each end upon blocks of wood, the distance between these supports being 75 feet, as shown in fig. 1. The supports are each 1 foot 4 inches broad, and the ends of the beam range with the extreme sides of the supports, making the total length of the beam 77 feet 8 inches. The beam is 4 feet $6\frac{3}{4}$ inches deep at the middle, 4 feet $0\frac{3}{4}$ inches deep at the ends, and 2 ft. 8 in. wide, in the body; but the top part of the beam is 2 ft. $11\frac{1}{2}$ in. wide, as will be seen by referring to fig. 2. The top part of the

Fig. 2.

MODEL OF STEPHENSON'S BRIDGE.
Transverse Section.
Scale, three-quarters of an inch=1 foot.

beam is formed into 6 longitudinal channels, by 7 plates of $6\frac{1}{2}$ inches deep, which run the whole length uf the beam, and are intended to prevent the top of the tube from huckling. These plates, it will be observed, diminish the internal height of the beam hy $6\frac{1}{2}$ inches, so that the dimen-

Fig. 3.

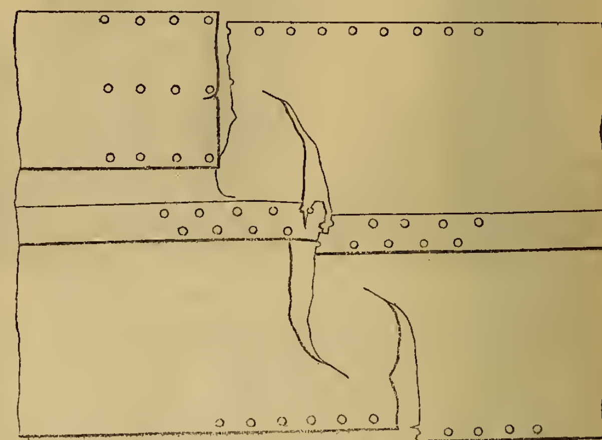


MODEL OF STEPHENSON'S BRIDGE.
View of Side where fracture took place.
Scale, three-quarters of an inch=1 foot.

sions of the hody of the beam are 2 feet 8 inches, by 3 feet $6\frac{1}{4}$. The seven vertical plates, and the horizontal plates above and below them which together constitute the top of the beam, are of No. 9 wire gauge. The sides of the beam are of No. 13, wire gauge, and the bottom of the beam of No. 7 wire gauge. On the outside surface of each side of the beam, and securely rivetted thereto, a $2\frac{1}{4}$ angle iron extends in the form of an arch from end to end of the beam; and a strip of rather thicker iron than No. 7 wire guage, runs along the centre of the bottom of the beam, to join longitudinally its constituent plates.

The tube hroke with a weight of 35 tons, the greatest deflection heing 4 inches. It had previously been loaded with a weight of 20 tons, and although there was some deflection, the beam completely regained its form when the weight was removed. The fracture took place about 3 feet from the centre of the beam, and is accurately represented by figs. 3 and 4. The

Fig. 4.



MODEL OF STEPHENSON'S BRIDGE.
Plan of Bottom when fracture took place.
Scale, three-quarters of an inch=1 foot.

method adopted for applying the weight to the heam is shewn in Fig. 1. A saddle piece of hard wood is placed within the beam on which rest two iron bars. These hars protrude through the sides of the beam, and from the ends of the hars, frames are suspended which are loaded with pig iron. A strong wooden beam supported hy dumbcrafts, passes transversely across the hollow heam, beneath the wooden saddle; so as to support the weight until the hanging frames are equally loaded. The dumbcrafts are then lowered, and the weight comes on the hollow iron beam in a steady manner. The beam, which as we have stated broke with a weight of 35 tons, is again heing repaired; and the effect is next to be tried of allowing a weight of 20 tons to remain on it for some length of time. Various hypothetical delineatious of the Menai Bridge have at different times appeared hut none of them that we have seen are correct. We can state with confidence that the form to be adopted is as nearly as possihle that of the experimental model at Mill-wall, and which the drawings we have given accurately represent.

## ART. VI.—ARTESIAN WELLS.

At a late meeting of the Institution of Civil Engineers, an interesting paper was read, describing the 'Effect of the deep Wells of the Metropolis on the Supply of Water in the London Basin,' by F. Braithwaite, Esq. The ohject was, to direct attention to the fact, that the numerous deep wells sunk in and near the metropolis are gradually draining the chalk basin; and that every additional well driven in search of water has the effect of diminishing the water level in all the wells already existing. As a proof of this fact, it was stated that, at a well in Combe's Brewery, sunk twenty years ago, the water rose to within seventy feet of the surface, hut that it now only rises to within one hundred and twenty feet; showing a diminution of fifty feet. From this and other instances, it was argued, that the supply of water is rapidly decreasing; and this was attributed as well to the improved under-drainage of the lands which receive the falling rain, as to the increased demand on the springs. It was thus shown, that the deep springs are not inexhaustihle,—and that obtaining water from them is attended with considerable expense and uncertainty. It was argued thence, that it is necessary to consider very carefully any attempts for obtaining a considerable supply of water from the chalk of the London Basin. A remarkable fact, also shown in one of the tables, is, that, on the 5th of April, 1802, there occurred a sudden depression of eighteen feet, of the springs, which lasted for half an hour; at the end of which time, thirteen feet of the eighteen were regained. The paper contained many interesting facts as to the general amount of the supply of water from the different strata; aud was illustrated by a series of plans,—the first of which was a map, on a large scale, taking St. Paul's as the centre, and describing around it a series of circles, with a radius of four miles. The external circle was divided into the thirty-two points of the compass; from which lines were drawn to the centre (St. Paul's). Upon these lines a series of sections were laid down,—exhibiting the various strata down to the chalk, as shown by the deep wells sunk in the districts between those lines, as far as the information could be gathered from those employed in sinking and boring them. These sections exhibit a remarkable contour of the chalk basin; and furnish fertile subject for speculative geology, as well as very valuable information as to the probable production of water from the various strata.—In the discussion which ensued, the Dean of Westminster spoke of the origin of subterraneous lakes or sheets of water, and the causes of the spontaneous ascent of the water towards the surface of the earth. He described the influence of the alternating impermeable beds of clay in retaining within the more porous strata the water received at their out-crop; whence, became evident, the cause of the spontaneous rising of water in the artesian wells sunk through the impermeable London clay down to the porous chalk basin into which the water had filtered, through the fissures and veins of flints, from the extensive denuded surface of chalk around the London district. After treating this subject at consieerable length, the Rev. Dr. alluded succinctly to the proposed speculation for supplying the metropolis with water from the River Colne; and described the labours of the Rev. Mr. Clutterbuck,—who, in papers read before the Institution, had demonstrated, by a long continued series of measurements of the water in the chalk hills of Hertfordshire, that all the water taken from that neighbourhood would have been abstracted from the supplies of the river Colne, and would have trenched upon the water-rights of the mill owners. He alluded also to the rain-guage experiments of Mr. J. Dickenson; who during many years, had found arithmetical evidence that the quantity of summer water in the River Colne varied with the quantity of rain in the preceding winter: and regulated his contracts for paper to be manufactured in the summer and autumn by the quantity of water shown in his winter rain-guage. These observations have been corroborated by foreign experiments. He then treated briefly the subject of artesian wells,—the increased temperature of the water in the exact ratio of their depth,—and the sympathy between the depression of water in the various wells throughout an extensive chalk district, proving the identity of origin of the supplies. As therefore, the number of deep wells was constantly increasing, the extra pumping upon one of them necessarily affected all within a certain distance around it. Mr. Clutterbuck's observations confirmed this. He had further observed that the surface line of subterranean sheets of water was not horizontal,—but inclined at a considerable angle, in consequence of the friction of the strata through which the water descended. The Dean concluded by drawing attention to the remarkable contour of the surface of the chalk exhibited in the sections,—upon which he proposed on a future occasion to offer some observations.

Mr. Braithwaite's opinions, it will be seen, do not altogether consortwith those which we have on several occasions expressed. We believe that out of the chalk, or from beneath the chalk, abundant water is obtainable to to supply all London, but the supply cannot be derived from superficial wells, into which the water is raised by an action akin to capillary attraction, and where the water taken from one well will lower the level of the wells around it. It is clear, however, that such an action cannot take place if the standing level of the reservoir in or beneath the chalk be reached; and the only question is, whether it can be reached at practicable depths.

## Art. VII.—ILLUSTRATIONS OF ENGLISH PALACES.

We this month give the first of a series of illustrations of English palaticl residences, which we trust will be, in some measure, representative of the architectural beauties of our renowned baronial halls. Although the artistic excellence of these illustrations has not been disregarded, our main purpose is to make them practically useful to the architect, and they will, therefore, comprize ground plans and other details, of architectural utility, instead of being merely a collection of pictures. As we have several of these plates already engraved, we believe that we can calculate upon their appearance monthly, without interruption. The series will, we anticipate, be completed in between two and three years, and one plate of the series will be given monthly until the whole have been given. We shall, of course, give a commentary upon the objects represented as the illustrations proceed. We are prevented, however, from commencing this commentary until next month, when it will be regularly continued.

## Art. VIII.—ARTIFICIAL MARBLE.

*Marble and Earthenware Pastes.*—A patent has recently been taken out by Messrs. Skinner and Whalley for the production of artificial marble, and the formation of improved earthenware pastes, by the use of a new composition of chalk and silica in combination with other materials. We shall here give the recipes for a few of the compounds:—

*Marble Paste,* No. 1.—Silica 64oz., chalk 84oz., Cornwall stone, 64oz., China clay 72oz., ball clay slip, 48 oz.

*Marble Paste,* No. 2.—Carbonate of lime 24 oz., flint in pulp, 32oz., China clay, 24 oz. Cornwall stone, 32 oz., ball clay 24oz. These pastes when burned, strongly resemble marble, and they may be ground or polished in the same manner. They may be stained by the oxide of chrome, and other metallic oxides.

*White Earthenware Body.*—Chalk 56 oz., flint 96 oz., ball clay 110oz. China clay, 240 oz., felspar, 32oz. If china clay be substituted for the ball clay the mass will be whiter.

*China body.*—Flint 128oz. chalk 90 oz. ball clay 144oz., China clay 192 oz., 32oz. of felspar will make the body more vitreous.

*Glaze without lead,* No. 1.—Chalk 28 oz., felspar 84 oz.

*Glaze without lead,* No. 2.—Flint, 32 oz., chalk 56 oz., China clay, 24 oz., Cornwall stone 356 oz., felspar 112 oz., ball clay, 24 oz. About 2oz. of finely powdered cobalt must be added to 400lb. of glaze, which is to be used in the usual manner.

*Glaze without Lead,* No. 3.—Powdered flint 100 oz., boracic acid 60 oz., soda 70 oz., whiting 50 oz.

If a glaze be required more transparent than usual, for printed and painted pottery, china, or earthenware, it can be made by the addition of any desirable quantity of this fritt to the glazes 1 and 2, in small proportions, which proportions will range from one proportion of fritt to two proportions of either of the glazes. The materials of this fritt, must be mixed together, and may be put into the fritt kiln now used by potters, or in seggars lined with silica or flint, and submitted to the heat of the potter's glost oven for twenty hours; it is then to be taken out and allowed to cool. It is afterwards reduced to pulp, powder, or slip in the usual manner.

## Art. IX.—NOTES OF THE MONTH..

*Carbonic Acid Gas in Steam Boilers.*—An extraordinary occurrence has taken place within the month in the boilers of the Peninsular and Oriental Steam Company's steamer *Montrose,* at Southampton. The vessel having been laid up for repair, made a trial trip to the mouth of the Southampton river, and about 48 hours after her return, when the boilers and machinery were all cold, a man, who was sent into the boiler for some purpose, suddenly fell down, as it was thought, in a fit. The alarm being given, the engineer of the vessel went in to bring him out, but no sooner had he reached the lower region of the boiler, than he too fell down in a state of insensibility. Fortunately, Mr, Lamb, the engineer of the Company, happened to be on board, and he immediately dispatched in another person with a rope round his waist, so that he might at once be pulled out if similarly affected; but this person, on being lowered down, immediately became senseless, and had to be drawn up again with all possible dispatch. As there happened to be a man-hole door directly over the furnaces, Mr. Lamb caused this door to be instantly removed, and no sooner was this done, than the men within the boiler began to revive. They were then taken out through the lower man-hole without inconvenience, and, after a little spirits had been administered, they perfectly recovered.

Our opinion having been requested as to the cause of this mysterious occurrence, we have tested some of the water taken from the river at Southampton, and upon pouring some of it into lime-water, a flocculent precipitate was abundantly deposited, shewing the existence of a large quantity of carbonic acid in the water. We have here, then, an explanation of the mystery. The effects produced were precisely those due to the presence of carbonic acid, and, as the whole of the water in the boiler was taken out of the river, without being diluted by water from the sea, it is not difficult to understand how the carbonic acid gas might accumulate in the boiler so as to produce the effects observed. When the boiler was blown off it would contain a mixture of carbonic acid and steam. The steam would be condensed as the boiler cooled, leaving the carbonic acid, on which the entering air, being lighter, would float. Had the mud-hole doors been opened, as well as the man-hole door in the top of the boiler, the carbonic acid could not have remained in the boiler, for, being heavier than air, it will run out of a hole in the bottom of a vessel in the same manner as water. It is very expedient, therefore, that in all steam vessels entering the port of Southampton, or any other river the water of which holds much vegetable matter in suspension, the mud-hole doors should be for some time removed, and the man-hole, or safety-valve, be for some time left open before any one ventures into the boiler; and before venturing he should lower a light.

*Penn's new Steam Engine.*—Messrs. Penn and Son, of Greenwich, have taken out a patent for a new steam engine, which it appears to us may be advantageously applied in some situations. For general purposes we hold it to be inferior to the oscillating engine, and, indeed, in the case of steam vessels fitted with paddle wheels, it is almost inapplicable; but in screw vessels, with the screw shaft lying very low, it offers some facilities of adaptation. This engine is substantially the trunk engine, first mentioned in one of Mr. Watt's patents, and for which, in an improved form, Mr. Humphreys took a patent eleven years ago. Instead, however, of the trunk being of an elliptical form, and being restricted to the upper end of the cylinder, it is, in Messrs. Penn's engine, made cylindrical, and projects through both ends of the cylinder, whereby any thrust occasioned by the angle of the connecting-rod, or the weight of the piston, is prevented from exercising an injurious operation upon the sides of the cylinder. The trunk, therefore, in which the conneeting-rod is contained, and which is made of suffieient diameter to permit of the vibration demanded hy the crank, is in effeet, a hollow piston-rod, protruding through the cylinder eover and cylinder hottom, and to the centre of which, in the line of the piston, the end of the eonnecting-rod is jointed. The eylinder lies in a horizontal position: the air-pump is also horizontal, and is fitted with a solid piston and spindle valves at eaeh end, to make it douhle acting. A meehanism is included in the patent for the preventing the ends of screw-propeller shafts, or steps of any heavy maehinery, from wearing into ruts, and for facilitating the application of oil or water to the rubbing surfaces. It consists in plaeing the centre of the steel disc, which receives the thrust, something out of the central line of the revolving-shaft, and then putting the steel dise into slow rotation hy wheel-work, so as to imitate the action of machines for polishing lenses. Every scrateh upon the surfaees thus tends to confound and ohliterate preceding scratches, and the effect is rather to correct than to create any inequality of surface, at the same time that every part of the rubbing surfaces become luhricated in succession.

*The Wellington Arch Statue.*—The inauguration of the Wellington statue, which is to he placed on the arch at Constitution Hill, is expeeted to take place in the first week in August. The following are a few of the prineipal dimensions:—from the nose of the horse to the tail, ths length is twenty-six feet; girth round the horse twenty-two feet eight inches; girth of horses arm, five feet, four inches. The weight is computed to he about forty tons. The thickness of the metal varies from one to three inches, with internal rihs where neeessary to give the required strcngth. The legs of the horse are cast solid. The statue is made in eight pieees, which are so joined together as to make the joining imperceptihle. The model for the statue was hegun in in 1840, and took the artist and his son three years to complete. It was quite a piece of engineering to keep so large a model in shape during the progress of the work, the weight of the model heing near one hundred tons. It was formed upon a turning platform, like the platform of a swivel hridge, so as enahle it to he moved round easily, and the skeleton part of the model was framed with strong timhers firmly bound together, in the same manner as a ship. Messrs. Grissell and Peto have contracted to set the statue in its place for the sum of £2000, and considerahle preparations are being made in the construetion of a carriage for transporting it, as if it were a great feat to move such a mass. Some of the engineers have as heavy hoilers and other pieees of machinery to wheel about, which is done without difficulty or fuss, and we think a smaller sum might have sufficed for such a service. The statue we may add represents the Duke of Wellington as he appeared at the hattle of Waterloo on his favorite horse, Copenhagen. The priee of the statue as fixed by Mr. Wyatt's cantract with the eommittee is £30,000.

*A Critic criticised.*—A paper of large pretensions, entitled the "Critic," has recently allowed itself to he seduced into some remarks on Diamond Dust, whieh would seem to indicate that questions of natural philosophy are beyond its legitimate sphere; unless, indeed, we are to suppose that the paragraph is the *puff-philosophic* of the advertising importers of Diamond Dust.—The "Critic" says:—"Reeently there has been a diseovery made of the peculiar power of diamond dust upon steel: it gives the finest edge to all kinds of cutlery, and threatens to displaee the hone of Hungary. It is well known that in cutting a diamond (the hardest substance in nature) the dust is plaeed on the teeth of the saw—to which it adheres, and thus permits the instrument to make its way through the gem. To this dust, too, is to be attrihuted solely the power of man to make hrilliants from rough diamonds; from the dust is ohtained the perfection of the geometrical symmetry whieh is one of the chief heauties of the mineral, and also that adamantine polish whieh nothing can injure or affeet, save a substance of its own nature. The power of the diamond upon steel is remarkahle: it is known to paralyze the magnet in some instances—and may there not he some peculiar operation upon steel with which philosophers have not yet taught us to be familiar? *How is it that a diamond cast into a crucible of melted iron converts the latter into steel?* Whatever may be said, it is evident that the Diamond Dust for sharpening razors, knives, and eutlery, is a novelty whieh is likely to command the attention of the publie, whether or not it is agreed that there is anything *beyond* the superior hardness of the dust over the steel to give that keenness of edge that has surprised all whe have used it." This appears to us to be a very good illustration of the art of making mueh ado about nothing. Before beating his hrains to aeeount for a simple faet, the Critic should first satisfy himself that the eause is not already known; there are quite enough difficulties in nature to be solved without these self-ereated diffieulties of pseudo philosophers, and it would be well f sueh would learn the elements of science, before venturing into its mysteries. The staggering fact which is considered to be unaccountable by this sage critie, is embodied in the question "How is it that a diamond cast into a erueible of molted iron converts the latter into steel?" No one possessing the slightest knowledge of the constitution of these bodies and of the rationale of the ordinary conversion of iron into steel eould fail to furnish a ready answer to this question. Steel is simply iron in eombination with carbon, and the conversion of iron into steel is effected by hringing the metal when heated, into contact with any hody which will readily part with its carhon. Diamond, as it happens, is pnre earhon, and of eourse will transform iron into steel if allowed to combine with it. We reeommend our marvel-seeking critie to purehase a primer, and to proceed to school forthwith.

*New Atlantic Steamers.*—The Halifax Steam Company has just concluded contracts for three new steam-vessels, to enahle them to fulfil their contract recently entered into with the English Goverment, for carrying a weekly mail between Liverpool and the United States. The new vessels will be 2,000 tons burden, and 700 horse power. The vessels are to he of wood, and will he constructed hy Messrs. Steel and Co., of Greenock; the engines will be by Mr. Robert Napier, of Glasgow, hy whom all the engines of the vessels now belonging to the Halifax Company have been built. The same Company proposes to have one vessel of iron. Iron, it appears to us, would be a greatly preferable material for vessels exposed to the risk of collision with ieehergs on the hanks of Newfoundland. With respect to the corrosion of the iron, about whieh fears are entertained, the method of preventing both corrosion and the adhesion of harnicles in tropical climates has heen already explained in the ARTIZAN.

*Implements exhibited at the Royal Agricultaral Society.*—The annual meeting of the Royal Agrieultural Soeiety, has just been held at Newcastle. The implements exhibited are somewhat less in numher than last year, hut appear on the whole to he superior in point of quality. The list comprises 41 carts, 45 ehaff, hay, and straw cutters, 18 churns, 15 crushers, 8 clod crushers, 6 corn-dressing maehines, 20 dihhling maehines, 9 drills, 8 corn and seed drills, 11 drills for general purposes, 21 drill and pulverising machines, 15 fences and specimens of fencing, 4 fire-engines, 18 iron gates, 33 harrows, 4 hay-making machines, 18 horse hoes, 19 hurdles, 18 machines for making hricks, drain tiles, soles, &c., 29 mills, 89 ploughs, 18 miscellaneous ditto, 5 pumps, 11 rakes, 12 rollers, 12 searifiers, 6 steaming apparatus, 15 thrashing maehines, 7 tree guards, 4 troughs, 8 turnip eutters, 15 weighing machines, 25 patent wheels and axles, 4 whippletrees, 2 winnowing machines, and 138 other articles whieh the eommittee deserihe as "not capahle of heing classified among the preeeding." Count Gufenherg, of Finland, exhihited a corn drill, by whieh the seed was supplied on a new principle, and whieh attracted mueh attention. Ainslie's tile making machine, hy which from 1000 to 1500 tiles ean be made in the hour, was also a prominent object. Messrs. Young, of Edinhurgh, exhihited some gates on the sympathetie principle, wherehy the four gates of a road, crossing a railway, are opened when one of them is opened—a connexion heing made hetween them so as to make their action simultaneous. Hornsby's Winnowing Machine is eapable of separating the corn from the ehaff as it comes from the thrashing maehine, without the use of a jaek riddle. The peculiarity of this machine lies in the use of a spike roller working through a grating, the roller and grating being so arranged as to form a hopper; and it can be adjusted to suit corn either in rough chaff or in any other state. It is also fitted with a shaking screen at the hottom, which more effectually cleans the eorn from all kinds of small seeds than a fixed sereen. In Stratton's Norwegian Harrow, an entirely new mode of *raising* and *lowering* the implement, and of regulating the depth at whieh it works in the ground, or of raising it quite out of the ground, is introduced, so as to put it instantly in a condition to be transported from field to field. By this eonstruction a slight exertion of foree will do all that is required to lift the heaviest implement, as the draft of the horses hy a simple deviee is rendered availahle for raising the teeth of the implement out of the ground. Coleman's Patent Expanding Lever Harrow consists of a number of spiked iron hars, jointed to one another at the ends in parallelograms. It is suitahle either for level or for ridge land—the flexibility of the joints allowing its adaptation to the most ahrupt inequalities. It is much to he desired that some authentic record should he kept of the designs of machinery suhmitted for inspeetion at these annual gatherings. The accessibility of such a register would eontrihute more to future improvement than any measure we can at present eontemplate.

*Engineering under Government.*—The department of engineering and machinery in Her Majesty's doekyards has been extended and put on a higher footing. Mr. Lloyd is the chief at Woolwich. Mr. Murray, assistant to Mr. Lloyd, has been appointed superintendent engineer at Portsmouth. Mr. A. Lawrie has been appointed engineer of Chatham estahlishment; and to have a salary of £400 per unnum. He is to have charge of all the machinery. Mr. C. Atherton to be assistant to chief engineer at Woolwich, vice Murray, appointed chief engineer at Portsmouth; Mr. Dinnen, late foreman of Engineers, to be inspeetor of maehinery; and Mr. Trickett to be assistant inspector of maehinery. Mr. Kingston, who has lately retired from one of these offiees, after a life-time spent in the public serviee, has reeeived the magnifieent superannuation allowance of £75 a year. Fine encouragement this for his sueeessors! Mr. Kingston was a meehanist of great ability and praetieal experienee: he introduced various improvements into the machinery of steam vessels, of which the valves, known as Kingston's valves, which are applied to the blow-off, and other pipes, where they penetrate the ship's side, are the most widely known. These valves obviate the risk of leakage, should the pipes within the ship be broken; and they are now widely used, as well in the merehant as in the government service. Had Mr. Kingston hrought his ingenuity into the market, instead of presenting its fruits to a thankless government, he would have realized a different result: but every incident of the naval administration of this country, clearly shows that those who have influence can obtain anything, whatever be their demerits; while the really useful servants of the country can get nothing in repayment of their deserts. Had Mr. Kingston, instead of being an humble and efficient mechanist, been a useless sucker of aristocracy, a different fate would have awaited him. He would then no doubt have succeeded in obtaining a handsome pension. But the time is fast coming when neither Whigs nor Tories will be able to make the offices of government a monopoly of their own. A different order of men is springing up, who will insist on reaping whatever they sow, and among whom the superfine coxcombs, who now monopolize the honour, will only fetch what they are worth.

*A Learned Artizan.*—Elihu Burritt, an American blacksmith, who has recently visited this country as the apostle of the doctrine of the holiness of peace, has, by dint of untiring perseverance during his leisure hours, made made himself acquainted with about 50 different languages. He is a proficient in the most difficult languages of Asia, including Russian, Sclavonic, Armenian, Chaldee, Syriac, Arabic, Ethiopic, Sanscrit, and Tamul, and is well acquainted with many of the European languages now falling into disuse or become obsolete, among which may be mentioned Gaelic, Welch, Celtic, Gothic, Saxon, and Icelandic. Elihu Burritt is about 35 years of age. It is his practice to devote eight hours to work, eight hours to study, and eight hours to physical indulgence and rest. We would hold this example up to the working men of England, to show how much may be done by persevering efforts, in spite of every disadvantage. Mr. Burritt, however, is not a mere linguist, but is a man of great intelligence, large information, and considerable literary attainments. His "olive leaves," in which he has advocated the principles of peace, have had a very wide circlation in America, and have not been without their effect even in this country. In the first numbers of Douglas Jerrold's new paper there is a communication from Elihu Burritt entitled, "The last hour of the League," in which he says,—"While the social and commercial ties that connected the two countries were thus strained almost to breaking, the friends of peace in America had looked around for other lines of social tendencies which might be thrown across the agitated waters, to strengthen the moorings of the Anglo-Saxon race. For one, I had looked, as it were, into every mail-bag borne over the ocean, and counted every letter as an American and an English vote for peace. At this period of solicitude and peril, the abolition of the English Corn Laws, the great peace-measure of the age, was laboriously approaching a doubtful issue. At the most critical attitude of the Oregon question, expectation oscillated between hope and fear, with regard to the fate of the Corn Bill in the British House of Lords. But the news by the Hibernia dispelled the last cloud of doubt. In the dark ages of human violence, a fiery sword appeared in the sky to barbarous imaginations, portending wide-spread carnage and desolation. The wheaten sheaf now seemed to take its place among the stars of promise, as a token of peace and plenty to the world." The editor remarks, that the learned blacksmith's communications are to be continued in his paper, and they can hardly fail to prove highly attractive.

*Minister of Public Works.*—It is now proposed that we should have a minister of Public Works, and the suggestion has been received with favour. The idea has been suggested by Mr Pierce Mahony, and the following is an outline of his suggestions:—To this minister he would intrust the direction of all public works and loans in aid of works, at home or in the colonies. He should have under-secretaries, and the boards of works and loan commissioners placed under him instead of the Treasury. The Boards of Works of England, Ireland and Scotland, would be in the possession of the Ordnance surveys, and such statistics as they necessarily collect in the discharge of their functions. At present, when an Irish landed proprietor wishes to drain his estate, his first step is to give an undertaking to pay the expenses of the Board of Works, in making a preliminary survey. The Commissioners, having received the Report of their own officer, either adopt or reject the application; hut their acceptance does not enable the work to go on until the Treasury give their approbation. Mr. Mahony would have the board report on all public works, to a minister charged especially with their superintendence, instead of the Treasury, and be guided by his decision. If the minister did not make up his mind against any plan reported, he would allow it to proceed; if convinced that the projectors were in error, he would communicate with them, and they would either at once desist, or appeal to Parliament at their own risk. The Houses of Parliament would pay the same defereuce to the minister's opinion that they do to the opinions of the Boards of Admiralty and Ordnance.

*Continental Canals.* While railways are in the ascendant with us, the construction of canals is still going on in Continental Europe. "In France," says the "*Journal des Travaux Publics,*" "the original plan for the maritime canal of Caen is still carried out with energy; 2,800,000 francs have been expended in the erection of one of the four walls of the basin, a new bed for the Orme 2,700 metres long, and the two jetties of Oysterham. Some angry observations have been made on account of the opening of the Orme having cost 800,000 francs, while the original estimates amounted only to 280,000. 1,200,000 francs have been voted for improving the navigation of the Vilaine in the environs of Rennes, comprising earthwork, excavations, aqueducts, bridges, &c. Now a credit of 15,000,000 francs is asked for the completion of the branch canal to the Garonne, between Toulouse and Casterts." In Germany, the king of Bavaria has realised the conception of Charlemagne, by the completion of a canal, uniting the Rhine and the Danube. This canal takes its rise at Bamberg, and falls into the Danube at Kehleim; it is called the Lewis Canal, and has been twelve years in executing. By this means, a vessel from London or Rotterdam will have uninterrupted passage through Bavaria, Austria, Hungary and Wallachia, into the Black Sea, and thence to the Mediterranean. This canal is likely to benefit not only Holland and Belgium, but also some parts of France and Switzerland. The various land-locked seas of Europe are now connected by means of canals with each other and the ocean. The French canal of the two seas joins the Mediterranean with the ocean; the canal of Holstein unites the Baltic to the North Sea; and the Lewis canal places in communication the North Sea with the Black Sea.

*The Kitchen of the Reform Club.*—The kitchen of the Reform Club, of which we lately gave a slender account, is fully described and illustratedin M. Soyer's new work on cookery, and the arrangements are well worthy of the attention of the architect. The ice-drawers and dresser, the vegetable boxes, the suspended frame for meat, game, &c., the meat-safe, the pestle and mortar, the marble fish-slab, the charcoal stove and hot plate, the roasting range, the dinner-lift, by which the dishes are conveyed direct from the kitchen to the eating-room, the kitchen table, and steam-closet, are excellently devised and arranged in the most commodious manner. The *roasting fire-place* is on a plan entirely new; the size is 7 feet wide, and 5 feet 6 in. high; the bars are vertical, opening at one end, and supported upon castors, which allows the cleaning of it with ease, and affords access for repairing the boiler without pulling down any of the work around it; at the back of the stove, in front of the boiler, are thick Welsh lumps, which so retain the heat that hot water can be obtained twenty-four hours after the fire is put out. The great advantage of this range is that, from the smallest bird to the largest joint, even a baron of beef, can be cooked to perfection, with a small expenditure of coals, for there is only 4½ inches depth of coals between the bars and the back of the grate. The broiling, too, can be done in a superior style, by means of a double gridiron suspended from an extending bracket, hooked over the top bar. The gas stove we described in our former notice: it is formed in five separate compartments, with pipes, and cocks, so that the whole five or only one may be burnt. The heat is, of course, obtained the moment the gas is lit, and is comparatively free from carbonic acid, which is so pernicious, especially in small kitchens; it creates neither dust nor smell, and is free from smoke. With the aid of a new octagonal trivet, nine stewpans can be placed over it, without the fear of upsetting, some only simmering, and others boiling at the same time, and by the gentle simmering, the cook is enabled the more readily to extract the fat from soups or sauces, and the cookery is in every respect better than if a fiercer fire had been employed. M. Soyer next describes his own Kitchen at Home, and also gives a form of Bachelor's Kitchen; he then enters upon the explanation of a system of *cuisine bourgeoise*, or domestic cookery; in which he thus speaks of the French *pot-au-feu*; "out of this earthen pot comes the favourite soup and bouilli, which has been everlastingly famed as having been the support of several generations of all classes of society in France; from the opulent to the poorest individuals, all pay tribute to its excellence and worth. No dinner in France is served without soup, and no good soup is supposed to be made without the pot-au-feu." M. Soyer's work is one that will prove of utility to all classes: to architects in telling them how to construct kitchens, and to all other persons who are interested in the question of domestic economy. The wants of the middle and poorer classes are had regard to as well as those of the rich.

## Art. X.—NOVELTIES IN ART AND SCIENCE.

*How to produce Crimson Flame used in Theatres.*—A correspondent of the *Mechanics' Magazine* gives the following receipt for producing the crimson flame, so well known in theatrical displays, as "the blaze of triumph," which is used chiefly in concluding scenes: Procure one ounce of spirit of salt, put it into a cup, and introduce as much powdered nitrate of strontia as will make a moist pap, like bricklayer's thick mortar. Now put a gridiron over a slow fire, and on it place the cup; allow it to remain in a boiling state for two or three hours, until it is *very nearly dry*. Avoid the deleterious orange fumes that are evolved. Now, when the mixture has cooled, add about four ounces of the liquid called pyroxylic spirit, (price about 9s. 6d. per gallon,) and pour the whole into a white bottle for use. On standing, it deposits a sediment; do not use much of this. Of course, you can vary the quantity of pyroxylic spirit,—four or five ounces answer best. To use it, wind some common lamp-cotton on a nail into a ball of about two inches; drive this into the end of the torch, or the top of the altar, or the helmet of a "fire-fiend;" pour on it just as much of the liquid as the cotton will absorb, without allowing it to fall off in drops, and waste; then light it with a bit of paper, and you will see the effect.

*Novel Flour Mill.*—A new flour mill of greatly applauded powers has been for some time past attracting public attention in America, and the American Institute has lately awarded its gold medal to the inventor, Mr. Bogardus, in testimony of their approbation. Instead of the usual millstones, steel plates indented with circular grooves are employed, but the centres of the plates, instead of being in the same vertical line, are removed about an inch therefrom, whereby each grooved-plate becomes a species of circular shears that will cut, tear, and abrade any substance lying between them. On account of this peculiarity it is called the "Eccentric Mill," though the eccentricity might properly enough express a different conception. The grinding plates need not be large, and hence the mill may be made exceedingly portable. The plates revolve in the *same* direction, with somewhat different speeds—the quicker of the speeds being about 300 revolutions in the minute. The mill, it is stated, is suitable for grinding many substances besides wheat, and is also suitable for hulling rice, coffee, aad olives; grinding paint, ores, and bones for manure; powdering charcoal, and grinding flax seed, drugs, flint, snuff, or any other substance requiring to be levigated or reduced to powder, The fineness of the powder is regulated by a screw, which raises or lowers the step in which the shaft of one of the revolving plates runs. The material to be ground enters at the centre of the grinding surface as usual, and is delivered at the rim, whither it is carried by the centrifugal force. This mill appears to us to be susceptible of many applications; it is a very elegant machine, and deserves the attention it must command.

*Improvements in the Manufacture of Copperas and Alum.*—Mr. Spence, of Burgh, Cumberland, has taken out a patent for certain improvements in the manufacture of copperas and alum, the nature of which we shall here describe. After the iron pyrites has been calcined, it is placed in leaden cisterns, and sulphuric acid of the specific gravity 1·2 is poured over it; heat is then applied by means of steam pipes or otherwise until the temperature of the mass rises to about 200°, and after six hours, when the specific gravity of the acid will have increased to about 1·4, it is drawn off by means of a syphon. The same process is repeated six or seven times, extending, however, the time of maceration on each successive occasion, until at last free sulphur remains in the cistern. The liquid is then run into coolers to deposit its crystals, which it will do without evaporation In the manufacture of alum the shales are calcined first with a moderate heat, and if clay-stone is the substance used, it must be mingled with small coal or sawdust. The calcined mass is subjected to the action of sulphuric acid in cisterns as before, and is then drawn into shallow cisterns to crystallize. The novelty in the process consists in dispensing with evaporation in obtaining the crystals.

*Submerged Propeller,*—In a late number we gave a report of a committee of the Franklin Institute on the subject of submerged propellers. By the Liverpool papers, we find that Capt. W. C. Thompson, late of the Packet ship, Stephen Whitney, has taken out a patent in this country for one of the kinds of submerged propeller there reported on, and which did not give satisfactory results. The defective operation, however, is attributed by Capt. Thompson to faults of detail which can be remedied on a future occasion. The invention consists of paddle-wheels enclosed in air-tight cases, and projecting about eighteen inches through the bilges or bottom of the vessel. The wheels are made of a hollow drum, having small paddles attached to the periphery, and being set in motion by steam-engines in the usual manner. It is found that at or above a certain velocity, the water, by the centrifugal force of the paddles, is entirely expelled from the cases, and a partial vacuum is formed therein. This is seen by the fact, that when a hole is made in the cases, on the inside of the vessel and below the waterline, no water goes into the vessel, but air is drawn into the wheel-cases Twelve months ago wheels of this kind were tried in London, and gave a better result than was anticipated by practical engineers.

*The Electric Telegraph.*—It would appear from the statements of the capabilities of Messrs. Morse's telegraph, given in the American Papers, that the scheme is superior to any of the European ones. Morse's telegraph prints about 120 characters per minute, while Bain's, the only other system which prints the messages conveyed, can only register about 50 characters in the same time. The relative advantages of Wheatstone's and Bregnet's methods in point of the amount of intelligence wdich may be transmitted by means of them, are to the above, as 30 and 12 respectively. On the New York and Baltimore Railway, the lightning lately took some extraordinary liberties with the electric telegraph, upon which it signalized in a most eccentric manner. The *New York Sun* thus refers to the circumstance,—"Three thunder storms, each some thirty or sixty miles from the other, were all coming east on the telegraph route about the same time, and every discharge of electricity from either, was fully recorded *by the lightning itself* in the telegraph office at Jersey City, Philadelphia, Wilmington, or Baltimore. The wire became altogether unmanageable, and the operators being obliged to withdraw the batteries used for writing, the visitor from the clouds had the field to itself. The letters of Morse's telegraph alphabet which this natural lightning seemed to be the most partial to were L and T, but occasionally it went at the numerals, and dashed off 1's, 50's, 55's, 500's and 5000's, in its own rapid style. We learn that when two or more thunder clouds get in the same vicinity, and discharge their electricity at each other, or receive the fluid from the earth and return it again, or when ground lightning prevails, the effect on the telegraph wires is to produce a strange and original language, which may yet be made intelligible. In fact, each kind of lightning *speaks* for itself, and *writes* what it says."

*Sieman's Improvements in the Steam Engine.*—In a former number we made some mention of Sieman's Chronometric governor, which consists of a clock movement fitted with a weight and pendulum, carrying a toothed wheel round in one direction while the engine carries a similarly toothed wheel round in the opposite direction. A pinion at the end of a crank arm gears with both wheels, and when the two wheels are going at the same velocity, the pinion and crank remain stationary, but if one wheel travels faster than the other the pinion will be carried round and will turn the crank on its axis thereby affecting the throttle valve with which the crank is put in connexion. The present improvements relate partly to some modifications in the detail of this apparatus, which need not here be particularly described, as we fear the contrivance in spite of its ingenuity is not likely to come into practice. There is an improvement in the air pump mentioned, the design of which is to save the power at present consumed in lifting the condensing water out of a vacuum. In the case of engines employed to work vacuum pumps in sugar houses there may be a benefit in such an adaptation and in some such cases it has, we believe, been carried into effect, but in ordinary engines the gain would not repay the complication. There is also an engine without a crank for pumping the air out of the pipes of atmospheric railways the valves of which are wrought by means of tappets on the piston rod. We cannot discern much benefit in the arrangement.

*Volcanie Shoals.*—Numerous volcanic shoals have lately shown themselves in the Mediteranean. The *Malta Mail* states that the Graham volcanic shoal formed by the disappearance of Graham Island and volcano, had recently been examined by Commander Graves in the *Locust*. He spent two entire days in making his survey, from the result of which it has been ascertained that since it was last surveyed, in 1841, the sharp pinnacle then covered by only a fathom and a half of water, with deep soundings all around and an irregular bottom of lava, cinders, &c. has now sunk down to a depth of 32 fathoms (or as much under as at its greatest recorded elevation it was above water), and in its descent it has gradually spread out, and now forms a flat bank with a sand and coral incrustation, of a similar form and appearance to the banks marked in Captain Smyth's charts, and named by him nerita, triglia, prima marina patella, &c. all of which no doubt owe their origin to volcanic causes.

*Asphalte Pavement duriug Hot Weather.*—A Liverpool paper states that during the late very hot weather, the asphalte laid down in the streets of Manchester had actually became so soft, as to render it a nuifance to those persons who had to walk over it. It appears, however, that the material so affected was not real asphalte; and it was found that the portions of the Liverpool pavement which were laid down eight years ago with Seyssel Asphalte by Claridge's Company, were uninjured by the heat. We have not observed among the asphalte pavements of London, any such symptoms of softness as those described. Of course bitumen or any unskilful mixture of it with other substances, will become soft when subjected to the rays of a powerful sun, as is found to be the case in the seams of the decks of vessels in warm climates. But real asphalte ought to resist, and does resist, all such alternations of temperature as are known in this climate.

*Electro-plating of Zinc and Iron with Copper.*—Messrs. Elsner and Philip, of Berlin, have discovered a cheap mode of coating iron and zinc with copper, by the use of substitutes for the cyanuret of potassium. The iron article to be coated is first well cleaned in rain or soft water, and rubbed, before immersing it in the solution, which may be either chloride of potassium or chloride of sodium, with a little caustic ammonia added, or tartrate of potash, with a small portion of carbonate of potash. At the extremity of the wire, in connexion with the copper, or negative pole of the battery, is fixed a thin flattened copper plate, and the article to be coated is attached to the wire from the zinc, or positive pole, and both are then immersed in the exciting solution, the copper plate only partially. The liquid should be kept at a temperature of from 15 to 20 degrees centigrade, and the success of the operation depends greatly on the strength and uniformity of the galvanic current. When the chlorides are employed, the coating is of a dark natural copper colour; and with tartrate of potash, it assumes a red tinge, similar to the red oxide of copper. When sufficiently covered, the article is rubbed in saw-dust, and exposed to a current of warm air to dry, when it will take a fine polish, and resist all atmospheric influence. In coating zinc with copper, the same general principles will apply as for iron—only observing that, in proportion to the size of the article, the galvanic current must be less powerful for zinc. The surfaces must be perfectly smooth, and for this reason it is well to rub them thoroughly with fine sand. and polish with a brush. Tartrate of potash is the best existing liqnid for coating zinc.

*Improvements in the Manufacture of Porter and Ale.*—A patent has been taken out by Mr. Maugham, for improvements in the manufacture of ale, porter and other fermented liquors, which appears likely to become of some importance. After the liquor has undergone the ordinary process of fermentation, it is heated to such a temperature as to stop further fermentation, say from 150° to 160° and is then charged to any desired degree with carbonic acid gas. By this mode of treatment, fermented liquors can never become sour, as the various fermentation is checked effectually by the heat, and in close vessels there is no opportunity for its subsequent removal.

*Railway Signals.*—Mr. Gregory, the Engineer of the Croydon Railway, has erected a set of signals at the junction of the Bricklayers' Arms Branch, which are simple and intelligible. They consist of two semaphores, which are worked by the feet of the attendant, whose hands are left free to work the switches, the handles of which are conveniently placed for that purpose. In the absence of the attendant no trains will pass, as the signals are so contrived, that they will then indicate "danger" and "stop." It would be imprudent, we think, to lay too much stress upon this last peculiarity, since there would be nothing to prevent a man, when he had reason to expect the approach of a particular train, from fixing the handles in the particular position suitable for that train, and then absenting himself for a time. The main security must lie in a vigilant supervision, a well-arranged system of management, and the employment of steady and trustworthy men. If automatic signals and similar contrivances be used as auxiliaries, they will prove very useful; if intended to dispense with the more important requisites, they will only lead to a fallacious dependence and to inevitable disaster.

*Preparation of Photographic Plates.*—At a late meeting of the Paris Academy of Sciences a communication was received from M. de Nothomb, on the use of ammonia in the preparation of plates for photographic impressions. Hitherto, it has been considered important to carry on the process of photography in places as free as possible from ammonial emanations. M. de Nothomb is of quite a different opinion. He says, nothing tends so much to increase the rapidity of the operation as the use of ammonia. After preparing his plate in the usual way with the vapour of iodine, he exposes it to the vapour of a solution of ammonia; and at the end of twenty or thirty seconds, it is, according to his account, in a much better state than it would otherwise be to receive the impression that is required in the camera-obscura.

*Explosive Cotton.*—It is stated by a Swiss paper that Professor Schonbien has presented specimens of prepared cotton to the Natural History Society of Basle, possessing the explosive properties of gunpowder. Experiments were tried with a piece weighing 1-16th of an ounce, which, at the distance of 58 paces, sent a ball through two planks, and on another occasion, into a wall to the depth of $3\frac{3}{4}$ inches. A ball weighing $\frac{5}{8}$ of an ounce was driven by a dram weight of prepared cotton two inches into a deal at the distance of 200 paces. A small piece of this cotton laid on an anvil and struck with a hammer detonates without ignition; and the cotton may be washed in water and dried without affecting its singular properties.

*Preventing the Oxidation of Iron.*—Mr. Poole has taken out a patent for preventing the oxidation of iron, and for rendering malleable iron harder and more durable. The first improvement consists in adding to pig iron, when in a state of fusion, from two to ten per cent. of copper, tin, nickel, or antimony, whereby it is rendered more malleable and less subject to oxidation. The second improvement consists in coating iron with steel, or with a species of iron containing less carbon than common cast metal, by adding one part of blister steel to four parts of molten cast-iron, and then continuing to add scrap iron to the molten mass, until an iron rod is no longer rendered brittle by being dipped into the mixture. With this iron common iron is coated in the same manner as in the case of covering iron with brass. The third improvement consists in case-hardening iron, and preventing it from rusting, by the use of the ferrocyanide of sodium, calcium, or barium, avoiding the use of the ferrocyanide of potassium, which has already been employed for the purpose, as mentioned in Vol. III. of the ARTIZAN, p. 115. An alkaline bath formed with carbonate of soda or any of the other alkalies is used in conjunction with the ferrocyanide. The iron, to be case-hardened, requires to be heated to nearly a red heat, and is then to be immersed in the bath, where it is raised to a higher heat, after which it is to be plunged into the ferrocyanide previously fused in another vessel. The process appears to us to be far too complicated to be likely to come into general use, even if effectual for the purpose, of which we have doubts.

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## ART. XI.—ANALYSES OF BOOKS.

*Tables and Rules for Facilitating the Calculation of Earthwork, Land, Curves, and Gradients.* By J. B. HUNTINGDON, C.E. London: Weale, 1846.

Several tables for facilitating the computation of ea rthworks and other arithmetical processes incidental to railway canstruction, have lately been set before the public, of which those of Mr. Hughes, Mr. Bidder and Mr. Huntington appear to be the best adapted for practical application. The tables now before us, computed by Mr. Huntington, are extensive; and denote very clearly the labour they must save by the obvious labour their production must have involved. As we have already explained in former numbers of the "*Artizan*," when discoursing on the subject of earthworks, the subject divides itself into two departments. The first has reference to the original design of the work, and the balancing of quantities, and embraces the whole question of slopes, drainage, and formation: the second has reference chiefly to the execution of the work with the greatest economy and expedition, and to the arrangement of masses of earth in embankment according to their varieties of structure and composition. It is the first of these branches with which the engineer has chiefly to deal. To give contractors the opportunity of estimating the cost of earthworks, the engineer terto shew the several heights or depths to which the work pro ceeds. These always furnishes a plan and longitudinal section, the former to exhibit the situation and relative positions of the cuttings and embankments, and of the spoil banks, if any; and the latter to show the different heights or depths to which the work proceeds. When the ground is not level, or slopes in some other way than in the direction of the work, the cutting is termed a sideling one, and a plan and longitudinal section will not determine the quantity of earthwork. Some contractors take the transverse sectional area at different points along the line, and compute the cubical capacity by multiplying the length by the mean area; but this method gives only an approximation to the true result, and in important works should not be trusted. The true method of performing such computations is by means of the prismoidal formula. Mr. Huntingdon has appended to his tables an essay explanatory of this formula, to which we must refer those who desire to penetrate further into the subject. In addition to this essay, Mr. Huntingdon has introduced other essays upon kindred topics, but his speculations take we conceive, too hypothetical a a turn for a book of tables, and with some of his doctrines we do not agree. In this part of Mr. Huntingdon's performance there is too much of the mathematical gladiator, and not enough of the cautious judge sobered by experience. There are few heads that can carry mathematics into engineering without being turned; they cannot resist the opportunity of display, and instead of becoming able engineers, they generally subside into mere weavers of formulæ. Mr. Huntingdon stands in some danger of being overtaken by this fate, and we would counsel him to reject algebra for the future, when other instruments can serve the turn.

*A Hand-Book for Mapping, Engineering, and Architectural Drawing.* By B. P. WILME, Civil Engineer and Surveyor. London; Weale, 1846.

Mr. Wilme is already well known as an experienced surveyor and mechanical draughtsman, and we think that the present work is calculated to add to his reputation. Much labour has been expended upon it, and the work has been published in parts, having probably been written in such intervals of leisure as Mr. Wilme has been able to command among other more pressing occupations. Though this irregularity of production is inconsistent with publishers canons, it is, we think, conducive to the excellence of the work, and is necessary to give fair play to engineering authors; for practical men have not the leisure of *literati*, and by none other than practical men should works treating on engineering topics be attempted. The work contains specimens of coloured engineering drawings, maps, ornamental writing, examples of parliamentary plans, and other information of much value to those interested in such subjects. These specimens are exceedingly well executed and the letter-press accompanying them gives full information as to the means whereby industry may accomplish a like success. Mr. Wilme's merit is that he perfectly accomplishes what he attempts; the sphere of his labours is not one of the most exalted, but the service he renders is a useful service, and that is more than can be said for many of far more magnificent pretensions.

*The principles of Gothic Ecclesiastical Architecture.*—BY MATTHEW HOLBECHE BLOXAM. Eighth Edition. London: Bogue, 1846.

This is one of the Puseyite Architectural books of which we have of late years had so luxuriant a growth, and the public appetite seems to encourage their production, as Mr. Bloxam's work has now reached an eighth edition. We suspect, however, that this antedeluvian taste is restricted to a particular class of persons, and does not extend very far among the great mass of the public. The work before us is prettily illustratsd, and is a cheap book as well, but it is far too deeply tinctured by symbolism to be an acceptable guide to any except the dreaming monks of Oxford and Cambridge, or such as are afflicted with their architectnral disease.

*Lectures on Painting and Design.* By B. R. HAYDON. London: Longman and Co., 1846.

We have here the last literary production of poor Haydon. The present is the second volume of the lectures on Painting and Design, written by that eminent artist, and independently of their intrinsic merits, they will command the public attention as the dying legacy to literature of their unfortunate author. There are seven lectures in all, entitled Fuseli, Wilkie, Effect of different Societies in Literature, Science, and Art, Importance of a competent tribunal in art, Relative values of Fresco and Oil Painting, Elgin Marbles, and Beauty. Several of thc lectures we remember to have heard delivered at the London Institution, and we think they told better as lectures than they now tell as essays. With some overstrained and fantastic notions there are many useful and striking truths to be met with in them, and while a fastidious taste would find many things to which exception could be raised, the whole form a marvellous arabesque, which bears on every lineament the stamp of genius. The criticisms on the genius of Fuseli and Wilkie, appear to us to be remarkably just. The eccentric imaginations of the first-named artist, and Wilkie's unaccountable vaccillations of style, are commented on with much sobriety of thought, and much acuteness of observation. On the subject of Fresco, Mr. Haydon enlarges with much animation, aud he appears to have entertained greater hopes of artistic progress from the decoration of the new Houses of Parliament than are likely to be realized. The following are the only remarks we are able to tran- scribe :—

"The power of light, which the reflection of lime produces, shining through the colours placed on it, renders fresco, in spite of its deficiency of shadow, fitter for public decoration than oil, whose power lies in its gorgeous shadow. The power of fresco lies in light—the power of oil in depth and tone. Oil is luminous in shadow—fresco in light. A mighty space of luminous depth and 'darkness visible' gives a murky splendour to a hall or public building. A mighty space of silvery breadth and genial fleshliness, with lovely faces, and azure draperies, and sunny clouds, and heroic forms, elevates the spirits, and gives a gaiety and triumphant joy to the mind. The less shadow in decoration the better. Fresco is not desirable, because it is practised on a despotic material, and therefore requires a resolute and unerring hand, a fixed eye, and steady brain. It is desirable for its beauties—not for its obstructions. It is more difficult to paint with your feet than your hands; but that is no reason such a process is desirable. It would be better for fresco, if lime had the facilities of oil. It would bé no disadvadtage to be able to work up and retouch like Rembrandt, but it is not to be rejected because you cannot do it. You must take the process as it is; and as it has been done effectually by Italians and Greeks; as it has been effectually used as an engine by the modern Germans, though far from the perfection of Raffaelle, there is no reason on earth why it may not be also adopted by the British school."

"As colours are in reality tinted water, aud as fresco and stucco have a tendency to imbibe water, colours ground in water become incorporated with lime, water, and sand; and when dry they are not to be dissolved again by water; and the basis of fresco and its colours thus become harder than the stone by drying. If the stucco dry too rapidly, as it always does in a hot climate, it does not dry through ; and the hardness of the surface, from having imbibed carbonic acid from the atmosphere, hinders the interior from doing the same. The foundation of the stucco not being dry, very often, in its struggles to get at the carbonic acid, splits and blisters what has dried too soon over it as a skin. This was the reason that Vasari and the Italian artists were continually obliged to moisten as they went on, and this is the reason why, in my opinion, the climate of England, being moist, is more adapted for fresco than Italy itself. Here, certainly, we have no chance of fresco drying too soon on the surface ; but mortar dries here as hard as in Italy, and wherever mortar dries hard, there fresco may be safely practised. All the cant about our climate is puerile and morbid, and the ingenious objections of a sect in England, who are alarmed at the prospect of a masterly style of design and thinking being established at last, are not to be regarded."

The remarks upon the Elgin Marbles are most forcible, but the speculations on Beauty are in our judgment a failure. Some of the objections raised to Lord Jeffrey's hypothesis are feeble and captious, while the new doctrines propounded though they may hold for the most part in the domain of painting, break down at once when their general application is attempted. Some of our objections to Mr. Haydon's theory of beauty, we explained so far back as our fourth number, and we have not since seen occasion to modify the opinion we then expressed.

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## ART. XII.—PAPERS FOR REFERENCE.

### PREVENTION OF SMOKE.

*Extracts from the Report of Sir H. De la Beche, and Dr. Lyon Playfair.*

"The general principles upon which the combustion, or rather the prevention of smoke, may be effected are now well known, and admitted to be applicable in practice. Smoke consists of vapours produced by the partial combustion or distillation of coal, carrying up small particles of the fuel in mechanical snspension, and depositing, by the combustion of one of one of their constituents, carbonaceous matter in a fine state of division. The mode of preventing this smoke is to admit a sufficient quantity of air to effect the combustion of the carbonaceous matter, when the vapours are of a sufficiently elevated temperature to unite entirely with the oxygen of the air. If the temperature be not sufficiently elevated, the hydrogen of the vapours alone is consumed, and the carbon is separated in the fine state of division referred to. The gases produced by the complete combustion of fuel are colourless and invisible, and therefore do not come under the definition of the term smoke.

As the prevention of smoke implies the complete combustion of fuel, the result, as an abstract statement, always is, that more heat is generated, and a saving of fuel effected, when it is so consumed as to prevent the emission of smoke; but although this theoretical conclusion is undoubtedly correct, the practical results are not always consonant with this statement.

In consuming smoke in the usual way a quantity of cold air is introduced into the fire, and as this must be heated up to the temperature of the surrounding fuel, the loss of the latter may be equal to, or even greater than, the saving of the fuel from the combustion of the products of distillation. This often results in the careless use of furnaces constructed on the principle of smoke prevention, and thus leads to the contradictory statements given by those who have used such furnaces. But in all carefully conducted experiments the saving of fuel has been considerable, and the reason of this will be at once perceived, when it is considered that in addition to the combustion of the products of distillation, there is a large amount of fuel saved by the combustion of a gas called carbonic oxide, formed by the proper product of combustion, carbonic acid, taking up in its passage through the incandescent fuel, another portion of carbon, which escapes useless as regards the production of heat, unless burned by the air introduced at the bridge of the furnace, for the purpose of consuming the products of distillation.

From these considerations, and from experiments conducted under our inspection, with a view to determine this point to our satisfaction, we arrive at the conclusion, that although from careless management of fires there is often no saving, and that indeed there is frequently a loss of heat in the prevention of smoke, still that with careful management the prevention of smoke is in many cases attended with, and may in most cases be made to produce, an economy of fuel.

It may be necessary to remind your lordship that the cause of the emission of smoke in manufactories may be classed under three different heads, the relative importance of which involves very different considerations in any attempt to legislate for its prevention. These are :

1. The want of proper construction and adjustment between the fireplaces and the boilers, and the disproportionate sixe of the latter to the amount of work which they are expected to perform ; 2. The deficiency of draught, and improper construction of the flues leading to a chimney of inadequate height or capacity; 3. The carelessness of stoking and management by those entrusted with the charge of the fire-places and boilers."

The following extract points out one of the evasions resorted to by those convicted of occasioning the nuisance of smoke:—

"Most of the recent acts for this purpose are founded on the clause in the Derby Improvement Act, which enjoins a penalty 'for or in respect of every week during which such furnace or annoyance shall be so used or continued.' Now, as it cannot be proved that smoke does continue without cessation for a 'whole' week, seeing that, in all chimnies, there are periods when no smoke is emitted, and that smoky chimnies do not emit opaque smoke more than 20, and in the worst cases not more than 30, minutes in the hour, and that at night the small amount of fire kept on in the furnaces prevents the emission of smoke, no conviction can be obtained under this Act. Eminent legal authorities have been consulted, and have stated as their opinions that for the purposes of conviction, it is essential to prove that a furnace continues to smoke for a whole week without interruption."

The following are the conclusions deduced as regards the operation of the various acts at present in being:—

"The general result of examination is that they have proved unsuccessful.

1. From legal difficulties in procuring a conviction under the present ambiguous wording of the smoke clauses.

2. From inefficient supervision, and want of compulsory powers to make the execution of the Act imperative.

3. From want of adjustment in the amount of penalties, which in some cases are so small as to be practically useless; in others so large, and accompanied with so much expense in obtaining the conviction, as also to be inefficient."

The following general remarks upon the subject, are well deserving of attention:—

"Lord Lincoln's letter does not authorise us to make any recommendation as to legislative enactments; but it may be proper to mention that in every locality statements were made to us, that the only mode of obtaining an abatement of the nuisance was by summary conviction before a magistrate, the penalty being exacted once for any part of a day during which a chimney continues to smoke. At the same time it must be observed, that when we consider the magnitude of the interests affected, the expense attending alterations, when the cause of the evil is connected with deficient boiler room or inefficiency of draught, it is necessary that there should be provision made, to ensure the parties against undue application of powers generally entrusted. Your lordship will doubtless consider whether in such instances, it would be advisable to cause the expensive process of an appeal to a higher court to be the only means of redressing such grievance, or whether the same principle might not be applied as that contained in the Health of Towns Bill, to enable the Government, on application to that effect, to institute inquiry by a properly qualified officer, as to whether the convicted parties had fairly tried the ordinary means for abating the nuisance, and whether further time should not be granted for continued experiments.

It cannot for a moment be questioned, that the continued emission of smoke is an unnecessary consequence of the combustion of fuel, and that, as an abstract statement, it can be dispensed with. But your lordship will perceive that there are grave difficulties connected with a general law to the effect that it shall be unlawful for chimnies, after a certain date, to emit smoke. With regard to steam-engines, the processes for the prevention of smoke have been matured, and in very many instances successfully employed. In this case, therefore, a law to that effect could be most easily and promptly carried out. In other cases mentioned in Lord Lincoln's letter, such as distilleries, dye-works, &c., the legislature has already granted powers in the Manchester Local Act; and as there are certain instances is which processes for the prevention of smoke have with them proved successful, it may be anticipated that the nuisance arising from these sources may be much abated, if they be subjected to the general law wtth that forbearance and caution which, under certain cases, is so advisable. Thes are certain processes in glass-works, iron-furnaces, and potteries, in which it is neither possible nor desirable to apply a general law for the prevention of smoke; although the nuisance may be partially mitigated, by causing the steam-engines employed in them to be so constructed as not to emit smoke.

It is useless to expect, in the present state of our knowledge, that any law can be practically applied to the fire-places of common houses, which, in a large town like London, contribute very materially to the pollution of the atmosphere; but it may confidently be expected, that by a wise administration of a legislative enactment, carefully framed, a great progressive diminution of the smoke of large manufacturing towns will be effected, and that the most happy results will thus flow from this improvement, in the infc reed health and moral feeling of their population, the intimate connection nawhich with facilities for cleanliness has been so often pointed out."

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## SPECIFICATION OF ENGINES AND BOILERS OF "CITY OF LONDON" STEAMER.

[The following is the original specification of the engines and boilers of the City of London. The Cylinders, however, instead of being 67 inches diameter, have at the suggestion of Mr. Robert Napier been made 71 inches diameter, and the length of stroke has been made six feet six inches. Malleable iron framing too, has been substituted for the cast iron framing, and the boiler has been made in four pieces instead of three, with overturn flues as represented in a former number of the Artizan.]

*Specification of two Marine Steam Engines, and Machinery to be constructed for, and fitted up on board an iron vessel at present building for the Aberdeen Steam Navigation Company.*

*General arrangements.*—The said marine steam-engines to be constructed on the equal side lever principle, with strong cast iron frames for supporting the crank shafts, and stiffened by strong cast iron jib stays from the cylinders, which will form the support for the carriages of the starting bar, valve, and parallel motion shafts.

*Sole plates.*—The sole plates to be of cast iron, in one piece, not less than 2½ inches thick, with strong feathers underneath to go in between the sleepers.

*Cylinders.*—The cylinders to be of cast iron, 67 inches internal diamater, to be accurately bored out, and left not less than 1½ inches thick; to be free from all blown holes or other imperfections. The steam ports to be faced with brass not less than ½ inch thick; to be furnished with priming valves of brass at top and bottom, and also a cock at bottom for letting off the cold air at starting.

*Cylinder covers.*—The cylinder covers to be of cast iron, to have flat plates of the same let into or cast on their tops, so as to inclose a portion of air between the steam in cylinders and the atmosphere; the stuffing box gland to be lined with brass, and to have a ring of the same fitted into the bottom of stuffing box for the piston rod to work through. The cylinder cover, stuffing box, and gland to be turned and polished bright.

*Length of stroke.*—The length of stroke to be 6 feet.

*Condensers.*—The condensers to be cast upon the sole plates, having pipes through them for the reception of the main centres, and to be provided with barometers.

*Side frames.*—The side frames to be made in the most substantial manner, properly stayed together, and to the deck beams.

*Side levers.*—The side levers to be of cast iron, 17 feet long, about 3 feet deep, and not less than 2 inches thick in the blade; to be properly bushed with brass to receive the main centres, with all the other centres bored out, and fitted with studs to receive their respective parts of the engines.

*Air pumps.*—The air pumps to be 40 inches in diameter, and about 40 inches length of stroke; to be lined inside with brass or Muntz's metal not less than ⅜ths of an inch thick, and to be accurately bored out to receive the pump buckets.

*Foot and discharging valves.*—The foot and discharging valves and seats to be all made of brass, and fitted up in the best style of workmanship.

*Feed pumps.*—The feed pumps to be not less than 7 inches diameter, to be fitted up with brass plungers, packing glands and rings, to be worked from the air pump cross-heads; the feed pipes to be of copper 5lbs. to the square foot, well hammered, not less than 3¾ inches diameter; to be provided with suitable feed cocks and return valves of brass.

*Bilge pumps.*—The bilge pumps to be not less than 7 inches in diameter, to be fitted up and worked in a similar manner to the feed pumps, but with an arrangemement for throwing them out of gear; to be constructed so as to pump the water from either partition of the bilge into the sea, or the water from the sea on to the deck, either for washing the decks, or as a fire-pump, for which purpose it will require to be provided with 100 feet of leather pipe of 3½ inches diameter, with brass screws and nose-pipe.

*Brine pumps.*—The brine pumps to have brass plungers, valves, and seats, to be worked from the side levers, and arranged to throw in and out of gear, and to be fitted out complete with refrigerators of copper, &c.

*Hand pumps.*—The hand pump to be 5 inches in diameter, on the double action principle; to be lined with brass; plungers, stuffing-box gland, and valves to be also of brass; to be so constructed as to pump water from either partition of the bilge into the sea, from the sea into the boilers, or from the sea on the deck, either for washing the deck or in case of fire.

*Pistons.*—The pistons to be of cast iron, properly fitted with junk rings, and to be provided with three tiers of metallic packing, similar to those on board the *City of Aberdeen* steamer, ground accurately together, and turned to fit the cylinder steam tight.

*Piston rods.*—The piston rods to be of half converted steel, not less than 6¾ inches diameter; to be turned and polished, and properly fitted into the pistons and cross-heads.

*Cylinder cross-heads.*—The cylinder cross-heads to be of the best malleable iron, not less than 18 inches deep in the middle, by 5 inches thick in the blade; to be turned at the ends to receive side rods.

*Cylinder side rods.*—The cylinder side rods to be of the best malleable iron, not less than 4¾ inches diameter at the smallest part, and proportionally swelled towards the centre.

*Main centres.*—The main centres to be of the best malleable iron, not less than 10 inches diameter at the bearings, and to be ground and keyed into the pipe in condenser.

*Air pump rods.*—The air pump rods to be of the best malleable iron, cased with brass not less than ⅜ths of an inch thick, to be about 5 inches diameter, and properly turned and polished.

*Air pump side rods.*—The air pump side rods to be of malleable iron, not less than 4 inches diameter at the smallest part, and proportionally swelled towards the centre.

*Air pump buckets.*—The air pump buckets to be of brass, with brass valve and junk-ring for screwing down the packing.

*Cross tails.*—The cross tails to be of malleable iron, of the same dimensions as the cylinder cross-heads; to be fitted with links to embrace the side levers.

*Connecting rods.*—The connecting sod to be of malleable iron, not less than 7 inches diameter at the smallest part, and proportionally swelled towards the centre; to be fitted with straps and brass bushes to embrace the crank pins.

*Crank pins.*—The crank pins to be of the best malleable iron, not less than 9 inches diameter in the bush of connecting rod; to be securely fixed at one end into the crank eye.

*Cranks.*—The cranks to be of malleable iron, to be 3 feet long from centre to centre, and to be in strength proportional to the other parts of the engine. The ends of cranks for receiving loose end of crank pin to be bushed with brass.

*Paddle shafts.*—The intermediate and paddle shafts to be of the best malleable iron, not less than 13½ inches in diameter in the necks, to have the cranks properly shrunk on to their respective parts, with sufficient collars for preventing lateral motion.

*Eccentric straps and rods.*—The eccentric straps to be of brass, with a deep feather round them for strengthening them. The eccentric rods to be of malleable iron, about 4 inches diameter at the smallest part, and proportionably swelled towards the centre; the eccentric gabs to be bushed with brass, and to be provided with proper and convenient means for disengaging them.

*Paddle-wheels.*—The paddle-wheels to be of malleable iron, and to consist of 3 sets of arms, each set to be stiffened by 3 sets of rings, viz., one at the outside, another at the inside of the floats, and one in the centre of the arm, all properly rivetted together, and fitted into cast iron centres, each of which to be keyed to the shafts with 8 malleable iron keys. The wheels to be about 26 feet 6 inches in diameter, and to have about 20 floats each, of best elm, 9 feet long, by 2 feet 4 inches broad.

*Parallel motion.*—The parallel motion to be all made of malleable iron, with its centres bushed with brass, with proper keys for tightening them; each part to be in strength proportionate to the strain to which it is subjected.

*Valve motion.*—The valve motion to be made of malleable iron, having all its workings parts bushed with brass; the counter-balance weights to be of cast iron.

*Starting-bar gearing.*—The starting-bar gearing to be made convenient for engaging and disengaging at pleasure, having all its centres bushed with brass.

*Steam pipes.*—The main steam pipe to be made of best scrap boiler plate ⅜ths of an inch thick, and not less than 22 inches diameter; the branch steam pipes to be of the same thickness of plate, not less than 16 inches diameter, except the parts required for expansion, which are to be accurately bored and turned with a proper space between them for packing, and cast iron packing glands.

*Throttle, blow through, and snifting valves.*—The engines to be supplied with proper throttle, blow through, aud snifter valves, and seats of brass, similar to those in use on board the most modern vessels.

*Injection pipes.*—The injection pipes to be of copper; to have a cock of brass to draw the water from the bilge if required.

*Waste water pipes.*—The waste water pipes to be of cast iron, with stop valves and seats of brass.

*Expansion Valves.*—Expansion valves of brass to be fitted in a convenient situation, and so arranged as to cut off the steam at either of four different parts of the stroke.

*Sea valves.*—The blow-off, injection, and all the other pipes whose orifices are below the water-line, to be provided with sea valves of brass on Kingston's principle, where they pass through the ship's side, in addition to the common regulating cocks,

*Foundation bolts.*—The engines to be securely bolted down to the sleepers, so as to ensure their stability and efficient working.

*Oil cups.*—The whole of the working parts to be provided with Allen's patent lubricating cups.

*Crank coomings.*—The crank coomings to be of wrought iron, fitted with moveable gratings.

*Flooring and ladders.*—The engine room to ce completely floored with cast iron plates, having malleable iron ladders and cast iron stages to communicate with every part of the engine room; polished guard rails and circular wrought iron plinths to be fitted on the stages, ladders, and round the engines.

*Bearings.*—All the bearings to be provided with bushes of brass, truly bored and turned.

*Bolts and nuts.*—All the bolt-heads and nuts employed about the engines to be accurately dressed parallel and equal, so that each may fit its particular screw-key.

*Boilers,*—The boilers to be distinct in all their connections, and so constructed as to be in three pieces at least; to be perfectly detached, and a free passage to be left between them and the coal bunkers: each to be furnished with a stop-valve, so as to connect or shut off any boiler at pleasure. The boilers to be proved after they are fitted up in the vessel, in the presence of the company's engineer, with a water pressure of not less than 14½lbs. per square inch at the bottom of boiler, and shall be capable of generating sufficient steam at not less than 7lbs. pressure to fill the cylinders for 18 double strokes per minute with the passages open.

*Description of plates.*—The shell, flues, steam-chest, uptake, &c. to be made of the best scrap Staffordshire or Shropshire iron ⅜ths of an inch thick, and the bottoms of boilers, and 4 feet up the sides; the partitions the entire length of boilers, and the bottoms of ash-pits to be made of the same quality of iron, seven-sixteenths of an inch thick.

*Furnaces.*—The furnaces to be of Lowmoor iron, ⅜ths of an inch thick; each furnace to be composed of three plates (one on each side and one on top), the entire length of furnace.

*Coal boxes.*—The coal boxes to be of wrought iron, three-sixteenths of an inch thick, capable of containing about 100 tons of coal; to be supported at least 5 inches from the boilers and bulkhead abaft the boilers. The boxes that come down in front of boilers to be also of the same thickness of plate, and provided with suitable doors, &c. of malleable iron.

*Safety valves.*—The boilers to be provided with two safety valves and seats of brass, not less than 12 inches diameter, inclosed in a cast iron box to be weighted in the inside, and one of them to communicate with the engine room.

*Vacuum valves.*—A vacuum valve and seat of brass to be fitted on the top of each boiler in such a manner as shall effectually prevent the boiler from collapsing.

*Gauge cocks.*—Each boiler to be provided with not less than 4 brass gauge cocks.

*Glass gauges.*—A glass gauge, with suitable brass stuffing-boxes and cocks, to be attached to each boiler.

*Blow-off pipcs.*—The biow-off pipes to be of cast iron, having a clear passage to the sea of not less than 5 inchcs diameter; each boiler to have a blow-off valve or cock in addition to the two sea valves, as before mentioned.

*Funnel.*—The funnel to be about 60 inches diameter, and 45 feet long; to be of plates three-sixteenths of an inch thick, jump jointed, and flush rivetted with ornamental hoops round it where the plates join endways and the funnel stays are attached; to be supported by 8 stays from the paddle-boxes and the gunwale, with stretching screws at the bottom.

*Waste steam pipe.*—The waste steam pipe to be of copper, 4lbs. to the square foot, not less than 14 inches diameter, and to extend as high as the funnel stays, above which it will be formed into an ornamental ball for receiving the water, with a waste water pipe inside for carrying it away.

*Deck scuttles.*—The deck scuttles to be of cast iron, fitted with open grating and close covers.

*Ash grating.*—There will be required a grating immediately in front of the boilcrs, with hinged doors, to admit of the ashcs being hauled; also a derrick or other contrivance, with block and fauld, for hauling them.

*Bull's-eyes.*—Two glass bull's-eyes, 9 inches diameter, set in a wrought iron plate, will have to be let into the deck immediately above the centre of cylinders to admit light; the wrought iron frames to be of such a size as to admit a tackle to pass through when required.

*Engine-room tools.*—The contractor to supply a complete set of screw-keys, 2 large, 2 half-watch, and 2 small tackles, suitable for the size of the engines, 2 oil-tanks with cocks, each capable of holding 14 gallons, 2 tallow boxes, to contain 1 cwt. each, a wrought iron locker, with lock for holding 1 cwt. of waste, a complete set of firemens' tools, lamps, oil-cans, tallow-kettles, and combs for all the different screw-threads that may be used for the engines; or, in short, the engine-room is to be supplied with a complete set of engineers' and firemens' tools, so that the vessel may be sent to sea without further expense.

*Felting.*—The cylinders, slide casings, steam pipes, and boilers to be covered with felt 2 inches thick, and secured with battens of mahogany, with thin sheet lead soldered together under coal bunkers. The boilers to be bedded on a platform overlaid with putty.

*Painting.*—The whole of the engines, boilers, and other machinery to receive not less than two coats of metallic paint.

*Quality of materials.*—The cast iron to be cast, in all cases where practicable, from the best No. 3 pigs. The wrought iron to be of the best scrap, and the brass to consist of 6 proportions of copper to one of tin. Each of these is to be perfect of its kind, and free from cracks and flaws of any description whatsoever.

*How executed.*—The whole and every portion of the work before described, and with reference to the foregoing specifications, must be performed in a most substantial and workmanlike manner, whether mentioned herein or not, to the entire satisfaction of the Directors of the Aberdeen Steam Navigation Company, or their Inspector appointed by them, under whose superintendence the whole work shall be carried on and completed.

*Power to alter.*—It will be understood that the Company shall have power to make, during the progress of the work, any alteration or addition they may think necessary or beneficial, but no alteration shall be allowed to be made unless sanctioned by the Company's Inspector, and the conditions of said alteration signed by the Company's Chairman for the time being. In the event of any such alteration being made, the extra charge or deduction shall be agreed on before the change is entered into.

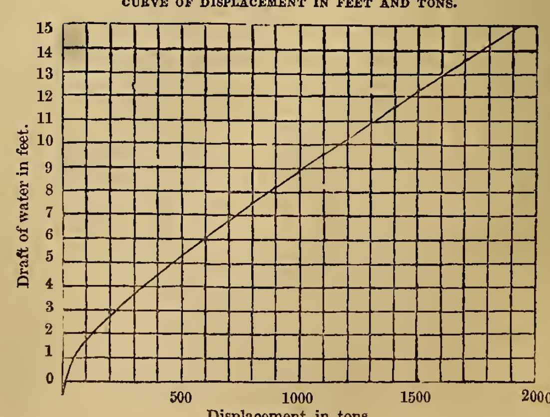
*Time for completion.*—For time of completion, see Specification of Vessel No. I.

*Aberdeen,* 3rd *May,* 1843.

*Calculation of the displacement of the iron steamer City of London, June,* 1843.

| | Immersion before shaft, cubic feet. | Displacement before shaft, in tons. | Immersion abaft shaft, in cubic feet. | Displacement abaft shaft, in tons. | Total immersion, in cubic feet. | Total displacement, in tons. | Rate ℔ foot of immersions in cubic feet. | Rate ℔ foot of displacement, in tons. |
|---|---|---|---|---|---|---|---|---|
| From 0 to 2 ft. WL | 2176.8 | 62·2 | 2129·6 | 60·8 | 4306·4 | 123·0 | 2153·2 | 61·5 |
| „ 2 to 4 ft. WL | 3893·8 | 111·2 | 3787·8 | 108·2 | 7681·6 | 219·4 | 3840·8 | 109·7 |
| „ 4 to 6 ft. WL | 4296.0 | 122·7 | 4378·2 | 125·1 | 8674·2 | 247·8 | 4337·1 | 123·9 |
| „ 6 to 10 ft. WL | 9279·6 | 265·1 | 9807·0 | 280·2 | 19086·6 | 545·3 | 4771·6 | 136·3 |
| „ 10 to 14 ft. WL | 10149·6 | 289·9 | 11094·0 | 317·0 | 21243·6 | 606·9 | 5310·9 | 151·7 |
| Total. | 29795·8 | 851·1 | 31196·6 | 891·3 | 60992·4 | 1742·4 | average. 4356·6 | average. 124·5 |
| Add displacement subtended by keel, stem, and stern-post | | | | | 1160·0 | 33.2 | | |
| Calculated by 152 sectional compartments | | | | | 62152·4 | 1775·6 | 4439·5 | 126·8 |
| From 0 up to the 2 feet WL | | | | | 4472·1 | 127·7 | 2236·0 | 63.8 |
| „ 0 up to the 4 feet WL | | | | | 12319·4 | 351·9 | 3079·8 | 87·9 |
| „ 0 up to the 6 feet WL | | | | | 21159·3 | 604·4 | 3526·5 | 100·7 |
| „ 0 up to the 10 feet WL | | | | | 40577·3 | 1159·2 | 4057·7 | 115·9 |
| „ 0 up to the 14 feet WL | | | | | 62152·4 | 1775·6 | 4439·7 | 126·8 |

CURVE OF DISPLACEMENT IN FEET AND TONS.



## Art. XIII.—THINGS OF THE DAY.

### FINE ARTS.

*Painting on Lava.*—On this subject respecting which we offered some remarks in our last number, M. Delecluze has stated some particulars to the Journal des Debats, which we may have recapitulate. The process he says, is not new, was but projected twenty years ago, by M. Mortèleque, a manufacturer of vitrifiable colours. Occupied, during much of his life, in perfecting the art of enamel painting, he experimented on various substances, with a view to obviating the injurious effects of the expansion and contraction of the metals on which the white enamel for the reception of painting is ordinarily applied. After many attempts, M. Mortèleque thought of lava—but there remained, to be overcome one objection to paintings on enamel—a certain vitreous appearance, unsuitable to the imitation of opaque objects. To the cure of this evil M. Mortèleque now devoted his efforts; and, having obtained a white enamel capable of being applied on lava, and whose elements permit the use of colours and their simultaneous developement, he composed a white, which, mixed with other colours, gives them a solidity of tone, that brings enamel painting nearly to the perfection of painting in oils, and even allows of re-touching to an important extent. His son-in-law, M. Hachette, followed in the same course; and amongst those who were struck with the applicability of this process to the decoration of edifices was M. Hittorf, the architect of Saint-Vincent-de-Paul. The material in question was brought into use for the inscription of the names of streets in the capital;—M. Abel de Pujol employed it on an altar of the Church of Sainte-Elizabeth;—and it was then determined to make that attempt upou its capacity for historical compositions on a vast scale which has resulted in this striking performance by M. Jollivet.

*Ecclesiastical Antiquities.*—The "*Nottingham Mercury*" states that "the interior of the beautiful ancient parish church of St. Peter, in that town, has just undergone a general repair and cleaning. The church consists of a spacious chancel, nave, north and south aisles, and a western tower and spire. The stone of the nave arcades (those on the south being of the first period, and those on the north being late in the second period) and the corbels of the roof (late third period work) have been cleaned of many years' accumulation of paint and whitewash: the walls of the chancel and nave have been re-drawn, and the Roman Ionic work, which for the last century has obscured the chancel and disfigured the nave, has been removed, so as to display a beautiful stone arch, erected about A.D. 1480. This improvement has been effected by the rector and churchwardens upon their own responsibility, at an outlay of £200. During the taking off of the whitewash several interesting discoveries were made. Upon the south capital of the chancel arch was discovered a piece of ancient church music, of about the year 1480, which was undoubtedly scratched upon the stone by the mason who worked it. The beautiful flowered diapering was also laid bare in many places, and it may not be uninteresting to know, that it was for the sake of hiding similar rich decorations that whitewash was first used in churches.

*Napoleon at Fontainebleau.*—A portrait of Napoleon by M. Delaroche, has for some time past been exhibiting at the establishment of Messrs. Paul and Dominic Colnaghi, Print sellers, Pall Mall, East. It represents the Emperor at Fontainebleau, on the celebrated 31st of March, 1814. The portrait is painted from recollection and from authenticated pictures of the original, with whom the artist was well acquainted. The fallen Emperor exhibits in this picture a perfect representation of utter physical depression. The limbs are listless and almost dead, and the features tell of the wreck of hope. The likeness is perfect; those who have the best means of judging of this fact have expressed their wonder that so correct a resemblance could be produced, when the portrait has not been painted from repeated sittings and the facilities usually afforded to artists. M. Delaroche in this picture has produced one of the best works of the present day. The tone of the painting harmonizes with the subject; all glare is avoided, and everything is chastened and subdued. The picture is about to be engraved by a French artist, M. François, in the line manner.

*Architecture of Railway Stations.*—The directors of the Blackburn and Preston Railway Company, have offered premiums of £100 and £50 for the best designs for railway stations, and there can be little doubt that attention having thus been directed to the subject, there will be some improvement introduced in that department of architecture. Thus with few exceptions, the railway structures, like the ordinary run of modern buildings, are new pieces of servile pedantry, without in most cases, even the slender redeeming quality of correctness of imitation, and totally unsuited for their application by a straining after an incongruous classicality. There is a total absence, not only of a due adaptation of style to the purposes of the structures, but also of the material to the localities in which they are situate. A granite station-house is an exotic on the fertile plains of England, while it would be appropriate in the rugged tracts in which it is found; and architects need never be driven to any transposition of materials, so long as each district contains materials which are readily obtained, and answer his purposes. A new style of architecture is now wanted, for new exigencies have sprung up; and to meet these we must have structures adapted to them, instead of the paltry and unmeaning reproductions of Greek temples and Gothic churches.

*Summary.*—A new picture gallery, on a splendid scale, is talked of for Rome; into which will be removed the great works of the ancient masters from such churches as are not esteemed fit, or safe, repositories for treasures of the kind and value:—the churches to have good copies, in their place.—The artists of Vienna recently celebrated the anniversary of Albert Durer's birth-day, by a festival held on an eminence in the neighbourhood of that metropolis.—The French Chamber of Deputies has voted a sum of money for the publication of the work of MM. Botta and Flandin on the ruins of Nineveh.—A very handsome window of stained glass, the cost of which has been defrayed by subscription of the clergy of the archdeaconry of St. Alban's, has just been fixed in the Abbey, near to the south door, in memory of the late Archdeacon Watson, D.D. It represents the martyrdom of St. Alban, who occupies the central light, and appears passing from the shrine of the heathen god, before which he had refused to burn incense, to the place of execution. On the one side a female is entreating him to revoke his determination, and on the other the executioner, who is said to have been converted by the occasion, kneels to ask his pardon and blessing. The secondary figures are the priest and his attendants, with the centurion and band of Roman soldiers.—Mr. Lough, the sculptor, has, we are informed, presented his plaster group of "Samson slaying the Philistines" to the College of Surgeons.—The Paris papers mention the death, at Ecouen, in his 75th year, of the celebrated flower-painter, Bessa, after a lingering illness. In his youth, Bessa was an actor in the stormy scenes of the first revolution; and took refuge, from the suspicions which had been awakened by his expressions of disgust at some of its atrocities, in the army. It was while serving on the staff in Holland that he acquired that passion for flower-painting to which he sacrificed his professional prospects and the advice of his friends, Grouchy, Moreau, Becker, Delmas, and others of the French generals.—The list of subscribers to the monument about to be erected at Norkœping, in honour of the late King of Sweden—which most persons know is the work of Schwanthaler—has been published: and it may give some measure of the popularity of that monarch, to state that, of 5,317 names which figure therein, upwards of 3,000 represent the subscriptions of simple sailors, soldiers, peasants and artizans.—A subscription has been opened in Leipsic, for the proposed monument in honour of Leibnitz; and in the course of the first day, the sum contributed amounted to 60,800 francs. The Royal Academy of Sciences of Berlin, which the philosopher founded, has struck a medal in his honour—having on one side his bust, and on the other allegorical figures representing the sciences which he cultivated.—The French Society for the Preservation of Historical Monuments, at its recent meeting at Metz, voted a variety of sums for the restoration of monuments belonging to the department iu which that town stands.—The old column on the Place du Chatelet, Paris, the first monument erected, at the commencement of the present century, to the glory of the armies of the Republic and the Empire—is to be repaired:—and colossal statutes, representing Commerce, Industry, Agriculture, and Navigation, are about to be placed at the corners of the Pont de la Concorde.—The renovation of the ancient and beautiful edifice of Malvern Abbey has just been completed.—At Nurnberg, the model for the statue of the Emperor Charles IV.—intended as commemorative of the fifth centenary of the Prague University, the oldest in Germany—has been exhibited. It is 14 feet high—weighs 40 cwt.—and is to cost 80,000 florins (about 9,000*l.*)—In the bronze statue of Huskisson, just completed in the royal brass foundry of Munich, Inspector Muller has resorted to a new method of dead chasing, for the sake of imparting to the work a uniform mellow appearance. By the use of different sorts of files a really different grain of the metal has been cut out, which the artist was able to produce in accordance with the nature of the part thus treated.—Cortot's bas-relief, in the Temple, at Paris, representing Louis XVI. attended by his courageous and faithful counsel Cléry, (which was removed, by way of precaution, during the new revolutionary effervescence of 1830,) is now being replaced.—The famous Cup, known as the Stratford Jubilee Cup—presented by the Mayor and Corporation of that town to David Garrick, in September, 1769, and used by him at the Shakspeare Festival which he instituted there, has again found its way into the market. This cup was formed out of the mulberry-tree which Shakspeare planted in his native town; and which the Rev. Francis Gastrell, the occupant of the poet's house, a century and a half later, sacriligiously cut down.—The figures on the great gate of the Cathedral of Senlis have been conjecturally restored by M. Robinet, the sculptor, under the direction of the architect, M. Daniel Ramée; with such success, it is said—in such perfect harmony with the general effect and all the details of the door—that the difference of colour alone would give any suspicion of their not being contemporaneous.—The Indian papers state that preparations are going forward for having the Meanee Column cast in Calcutta, and that 44 brass guns of various sizes, have been sent from Scinde for the purpose. The column is to be 130 feet in height, including the plinth, base, shaft, capital, and a figure of Britannia, 19 feet in height, which, with a pedestal of 7 feet, is to surmount the whole. The design was drawn by Colonel Waddington, of the Bombay Engineers. The column is to be of the florid Corinthian order, and its shaft 60 feet in height, and 7 feet in diameter. The figure will be of brass gilt. This column is destined to adorn Bombay, and will, as we hear, be erected on the esplanade near the Wellesley statue.

CONSTRUCTION.

*The Iron Trade.—Birmingham, July* 4.—A preliminary meeting of the South Staffordshire masters has just been held, at which it was resolved not only maintain present prices, but to propose an advance of about 1*l.* a ton on the maximum rates. This resolution has not been unanimously adopted, and there is some reason to believe that the approaching meeting may feel disposed rather to adopt a medium advance of about 5*s.* a ton. Since the settlement of the Oregon question, and with prospect of the American tariff being modified, extensive orders are expected; but those best acquainted with the iron trade in the States do not calculate much in this quarter. The chief cause of the demand is in the fact that the stocks on hand are extremely short, and that there is now a certainty that the demand for railway iron, for the next two years at least, will considerable exceed the means of supply.—*Glasgow, July* 4.—The price of Scotch pig-iron, dilivered free on board here, may be quoted to-day at 67*s.* 6*d.* to 68*s.* 6*d.* for No 1, and at 63*s.* 6*d.* to 64*s.* for No. 3, per ton, nett cash. Towards the close of the week our market assumed a firmer aspect, and extensive sales have been made at the following prices—67*s.*, 67*s.* 6*d.*, and 98*s.*, for No. 1; 63*s.* 6*d.* and 64*s.* for No. 3; 65*s.* 6*d.* for half No 1, and half No. 3, nett cash; 67*s.* and 68*s.*, with a small deposit for three and four months' delivery, for 3-5ths No 1 and 2-5ths for No. 3.—The usual quarterly meeting of the iron and coal masters of Staffordshire and Shropshire was held in Birmingham on Thursday. The attendance was numerous. Subsequently to the last quarter-day, there was an inclination, amongst the second-rate masters, to reduce the price, and in many instances needy makers did sell at rates below those agreed upon in April. On Thursday, however, the prices of last quarter-day were fully supported: bar iron went at about 10*l.*; hoop, 10*l.* 10*s.*; and pig fetched from 5*l.* 10*s.* to 4*l.* 15*s.* The demand for iron for railway purposes is not so great as has been represented.

*July* 11.—During the week there has been much business, and prices have advanced nearly 6*s.* per ton, and the market closed very firm at the quotations of 69*s.* to 70*s.* for No. 3, 72*s.* 6*d.* mixed Nos., and 75*s.* for all Nos. Cash f.o.b.—*July* 14.—There has been again an extensive business the last few days, and prices have gradually stiffened, and the market closed to-day very firm, at 70*s.* for No. 3; 72*s.* 6*d.* mixed Nos., to 75*s.* for all Nos. Cash, f. o. b.

*July* 17.—Prices have still an upward tendency. A large business has been done by the dealers at 70*s.* for No. 3, 72*s.* 6*d.* for mixed Nos., and 74*s.* to 75*s.* for all Nos. Cash f.o.b. Several contracts have been made by makers, at 77*s* 6*d.* for all No. 1. Cash on delivery.—*July* 18.—The price of Scotch pig iron. delivered free on board here, may be quoted to day at for all No. 1, and for 3-5ths No. 1, and 2-5ths No. 3, 75*s.* for all. No. 3, 70*s.* 6*d.* and 71*s.* 6*d.* The makers have affected sales at 80*s.* for mixed Nos., less 4 per cent. discount, cash in a month. The demand during the week has been very great, and the above prices for the present are firmly maintained, there being as many buyers as sellers.

*New Church, Charlotte-street, Fitzroy-square.*—A new Church dedicated to St. John has recently been completed in Charlotte-street Fitzroy-square, from the designs of Mr. Smith of Bedford Row. The Architecture is the Norman of the 12th Century. A Central gable with a handsome rose window is flanked with two towers and spires, the latter of wood, covered with diamond-shaped slates; the entire height of tower and spire being 120 feet. One of these towers has not yet been completed. The materials of the church and tower are Kentish rag, with Bath stone dressings. The interior of the church is divided into a nave and side aisles, by Norman columns and arches, above which are clerestory windows; and there is a large window of corresponding style at the east end. The roof is of open timbers, and the height from the floor to the ridge is 51 feet 10 inches; the nave is 86 feet in length, and 58 feet 5 inches wide; and the chancel is 30 feet, by 10 feet 6 inches. The pulpit is of circular design, sculptured in Caen stone: it is placed against the wall, and is entered by a low doorway, from the vestry. There is, likewise, a stone font, of Norman design. The cost of the entire structure was about £6,400. The purchase-money of the site, in addition, was £5,300. The foundation work was expensive, the artist having to provide 20 feet of concrete and gravel for the tower-base. The funds were formed of:—£5,000 left by a benevolent lady, for building a Church, the site to be chosen by the Bishop of London; the remainder being furnished by the Church Commissioners, and by public subscription.

*Mr. Bidder's Swing Bridge over the Wensum.*—A paper was read at a recent meeting of the Institution of Civil Engineers, descriptive of the swing bridge, erected by Mr. Bidder over the Wensum, at Norwich. The bridge covers by two spans, of 45 feet each, 85 feet of the river, and a portion of the land on the Norwich side. It was so constructed that, turning upon a centre pivot, fixed upon piles, the two sides opened simultaneously, thus balancing each other, and giving great facility in opening and shutting for the river navigation and the railway traffic. The details of this bridge were given, with the method of building it: it was of cast and wrought iron; its weight 347 tons, and was manufactured by Messrs. Grissell and Peto, from Mr. Bidder's designs. The paper was illustrated by a model, presented by Messrs. Grissell, and by a set of drawings by Mr. Cheffins. This species of bridge appears to be applicable in many situations. It is a simple and manageble species of construction being very much akin to a double jib crane.

*Summary.*—The *Hants Advertiser* states, that the contractors for boring the Artesian well on the Southampton common have refused to go on with the work unless guaranteed their expenses and fair profits; and accordingly, it has been given up to the Commissioners of Water Works. The boring was commenced in 1838, and has cost the town £12,886, while the contractors have expended £11,163 above that sum. In boring, 78 feet was found to be alluvium, the succeeding 304 feet London clay, then 97 feet plastic clay, and the rest chalk; in which the boring has been carried down to the great depth of about 821 feet, being a total of near 1,300 feet. There is no indication by which a judgment can be formed as to the depth to which the chalk may yet extend; and experience has shown that the chalk will not yield the water required, and that the great stream sought for must be obtained from under the chalk basin. The well, in its present state, will yield by pumping from 7,500 to 10,000 cubic feet of water per day. but that is but a fourth of the quantity it is calculated will be required for the rapidly increasing demands of the town.—The new post office at Hamburgh, now erecting after the designs of M. Charles Teauneuf, has next the street a length of 275 feet by a depth of 87 feet, including the courts 27 feet broad. The front, which is faced with sandstone and ornamented with cornices, rises to a height of 65 feet above the pavement; the roofs will be covered with thick lead plates. On the east side of the edifice will be erected the new telegraph tower, 150 feet above the pavement, or 169 feet above the average height of the Elbe, not including the signal staff. Immediately below the roof will be the observation room, of an octagon form, with a window at each end. The building will include the dwelling of the Director, printing and other offices. The clock will be at an elevation of 150 feet, lighted in the night by a Bude light: each of the two dials will be of the diameter of 6½ feet. All the rooms in the lower story of the Post-office will be vaulted.—The corporation of the Trinity House have purchased a license for the use of Dr. Pott's Atmospheric Pile Driver, and are making arrangements to use it in forming the foundations of an iron beacon, 60 feet high, to be placed upon the Goodwin Sands.—A correspondent of the *Morning Chronicle* thus writes from Rotterdam:—"July 13.—To-day the ground has been surveyed where the terminus of the railway from this city to Amsterdam is to be erected. Judging from the drawing, it will be one of the most splendid edifices of the kind in Europe. It is to be divided by columns into two parts, so that the trains may pass through, and the passengers in rainy weather be immediately under cover." We understand that it is to be completed in five months.—The sum of £20,000 has been bequeathed by the late Mrs. Magee, of Dublin, for the erection of a Presbyterian College in Ireland.—The inhabitants of Sandusky city, in America, have issued a card to the travelling public, warning them of the dangers that environ the Mad River Railway, between their city and Columbus, *via* Tiffin. The description is well worth quoting, if only for the amusing contrast it affords to the state of things on this side the Atlantic. "The road," say the complainants, "shows a reckless disregard of the lives of those passengers, who are deceived, as we were, by the stage agent at Columbus, who assured us there was no choice between the Mansfield and Tiffin routes; we, therefore, submitted to his arrangement. The road is constructed with the flat rails, and we hear it has received no repairs for the last ten years, and consequently the spikes are nearly all out, and those that are left are loose, allowing the rails to rise and fall as the cars pass over them. The spikes are generally missing at the joints of the rails—very many of the ends turn up from one to four or five inches. Some 12 miles from Sandusky city one of the rails was turned up with tremendous force, breaking through the bottom of the car between two seats, with a gentleman and lady on each. One escaped with a rent in his coat, the rail passing between the other's legs, bruising his knees, wrist and mouth, and cutting a large gash in his forehead. Half an inch variation would have taken his head from his shoulders. Accidents may happen on the best roads, but on this we think nothing but a special Providence prevents its occurrence every five minutes on the route." —From Frankfort, we see it stated that the different tradesmen of that city have formed themselves into a society, who, on their own account, and for their own benefit, have established a show of their products. They are a branch of the Society for the Improvement of the Working Classes.—The journeymen plasterers of Huddersfield have struck work for an advance of wages 6d. a day, making 21s. to 24s. a week. The masters are determined to resist.—It is proposed to erect, in St. Giles's, London, on a site recently obtained from the Woods and Forests, a lodging-house for one hundred labouring men, in which, at the lowest rate ever paid for lodgings, they may have accommodation of a perfectly clean character. The whole cost is estimated at £5000. Among the subscribers are Prince Albert, the Bishop of London, Duke of Sutherland, Earl Harrowby, &c.—The floods of the river Adige have of late caused such damage in the south of the Tyrol, that its embankment has been decided upon. The court councillor Dassetti, has just completed his report, which is accompanied by an instructive lithographed map of the valley of the Adige, from Meran to Boschetta. After the completion of the cut at Ischia Peratti, another more expensive cut will be commenced at Ischia Lidorno. The damming up of the Noce, one of the most impetuous and mischievous Alpine torrents, is also to be commenced.—At a late meeting at Liverpool, £3000 was subscribed as the commencement of a fund for the building of four new churches, entirely free, under Sir R. Peel's new act.

RAILWAYS.

*Metropolitan Railway Termini.*—The report of the commissioners appointed to investigate the various projects for establishing railway termini within, or in the immediate vicinity, of the metropolis, has been presented to the house of Lords. The following are its principal recommendations :—1. That on the north of the Thames no railway now before Parliament, or projected, be permitted to come within the limits described in our instructions. 2. That if at any time hereafter it should be deemed advisable to admit railways within those limits, this should be done in conformity with some uniform plan, carefully laid down under the authority of your Majesty's Government, and sanctioned by the wisdom of Parliament ; and that under no circumstances should the thoroughfares of the metropolis and and the property and comfort of its inhabitants be surrendered to seperate schemes brought forward at different times, and without reference to each other. 3. That on the south of the Thames, either the North Kent railway be permitted to have its terminus in Union street, and to join the terminus of the South Western Railway, at Waterloo Bridge ; or that the South Eastern Railway be permitted to extend to Waterloo bridge ; according as one or other of these lines may, upon a comparison of their general merits, receive the sanction of Parliament, and subject, in either case, to the conditions which we have pointed out in this report. 4. That the extension of the South Western Railway to London bridge be permitted, subject to the conditions pointed out in this report. 5. That a communication between the railways approaching London on the north and south sides of the river, and a connection between them and the docks being desirable, this should be effected by a railway encircling the metropolis, crossing the Thames at some point west of Vauxhall bridge, and not coming within the limits of our inquiry on the north side of the river. Whitehall, June 27th. 1846. (Signed) Canning, Dalhousie, John Johnson, Mayor, J. C. Herries, J. M. F. Smith.

*The Guages.*—In the House of Lords, on the 17th of July, Lord Dalhousie moved the resolutions of which he had given notice, taking a rapid retrospect of the question. He passed in his progress a warm eulogium on the Guage Commissioners, affirming that they had carried out their instructions not only with ability, but with industry and strict impartiality towards all parties. The noble lord quoted, at considerable length, the conclusions arrived at by the companies, together with the reversing recommendations of the board of Trade, proposing a divisional district and an exception in favour of all lines to the south of the Great Western. It would have been, he thought, both a breach of faith and an injustice towards the broad guage, on the part of Parliament, to have imposed upon them the outlay of a million in reducing their guage to the standard width; more particularly as no one could deny that the broad guage interests had been actuated by an attention to the public interest and convenience, to vast improvements in the existing modes of locomotion, which had stimulated the energies of other companies, that had redounded greatly to the public advantage. It would be necessary, supposing the resolutions ratified, that a general guage bill should be introduced, embodying their specific objects. Noble lords might say that a grander and more complete plan, based upon uniformity, should have been adopted; but the board of Trade had foregone the grand and comprehensive, for the practicable, the more workmanlike and just. He regretted that the state of the House, as regarded the attendance, was anything but in accordance with the importance of the subject. (There were scarcely a dozen lords present throughout the whole debate.) Lord Redesdale could not entirely concur in the recommendations of the Board of Trade, seeing that, if adopted, they would entirely preclude the possibility of this country ever attaining a uniform guage. Blame, he thought, was to be attached to the Commissioners for not reporting which was the better guage, and not as to the evils only of a break of guage. It was their duty to ascertain which guage furnished the greatest amount of power and speed compatible with convenience of working. A medium guage, he thought, would remove the entire difficulty. Great danger, he apprehended, would arise from the adoption of a double guage. An inquiry, he thought, should be instituted as to which was the better guage. Lord Kinnaird gave notice of his intention to move, at a future period, the appontment of a commission to inquire which was the better guage, and whether that better were not the medium of 6 feet. The Commissioners, he was of opinion, had adjudicated, not so much for the public as between two contending parties. The expense of reducing the working stock of all the lines to uniformity would not, upon uniform data furnished him by competent contractors, be more than 800,000*l.*; and it was perfectly practieable, as was proved in the case of the Eastern Counties, to widen the guage, though he would not say to the width of the Great Western.—The Earl of Galloway suggested the propriety of suspending all bills until this question was settled.—Lord Hatherton admitted the commercial inconvenience of a break of guage, but thought the break at Gloucester had been carefully aggravated. Had the break been in the hands of Mr. Saunders, Mr. Brunel, or Mr. Gooch, instead of Mr. Hudson, remedies would have been found, so that little complaint would have been heard. The broad guage, he conceived, must be still further extended, The communities of Liverpool and Manchester, would never be contented to allow Bristol and Exeter to be in possession of far greater speed. The Earl of Clarendon preferred the recommendations of the Board of Trade. The resolutions were then agreed to.

*Summary.*—Mr. Walker's Report on the crossing of the Tamar by a bridge or a ferry has been printed in the votes of the Commons. As respects the bridge, he recommends that it consist of four arches, all of the same size having 95 feet feet elevation in the middle openings and 92 feet in the side openings at the high water of neap tides. This will thus provide 100 feet in the centre, and 108 feet at half flood; "and although the bridge," says Mr. Walker, "will not by these means be perfectly harmless to the navigation, it will be so as to be nearly unobjectionable provided the railway object be contidered for the public good."—A correspondent of the *Morning Chronicle* says that a very curious railway was lately opened between Paris and Sceaux, a village celebrated for its *bal champetre* in the park. It is 7 miles long, and was constructed by M. Arnoux, inventor of the *trains articules*, or jointed. It consists entirely of curves, some of them of only 100 feet radius! The termini are circles where, as in the sharp turns, the first and last carriages come right opposite one another. The axles, instead of being fixed parallel, are free to turn on a pivot, and are made to place themselves in the radius of the curve by guide-wheels or rollers running obliqueiy against the inside of the rail.—The *Norfolk Chronicle* says that a bust and memoir of Mr. T. Gray have been presented to the Norwich Athenæum by certain gentlemen who have recently been exerting themselves in Mr. Gray's behalf.—The grass on the slopes of the cuttings and embankments between Slough and Paddington, has been nearly, throughout the 18 miles, destroyed by fire, being ignited by the live coals thrown out from the furnaces of the locomotives. Several patches of from half a mile to three quarters of a mile in length have been laid bare, and the roots, together with those of the growing shrubs destroyed.—A first-class passenger carriage constructed on a somewhat novel principle, has been built by Mr. J. Pownall, late superintendent of the Liverpool and Manchester, from the designs of Mr. H. Booth the secretary. It is described as being considerably longer than the present carriage, being, as it were, the bodies of four large coaches blended into one. It has 8 wheels, and is the first carriage, built with that number, six being the usnal complement. The novelty consists in the frame-work, and the manner of turning on the turntables, which are not large enough to turn so long a carriage without some new mechanical contrivance. The frame-work is divided into two portions, each resting independently upon 4 wheels. The body of the carriage is fixed upon these frames by means of central pivots, and the bottom of the body being a few inches higher than the frame-work, it follows that when 4 of the wheels, at either end, are pushed upon the turn-table, they and the frame attached to them may be turned to any angle with the others. The other four wheels may be next sent on to the table, and the operation of bringing these in a line with the first will turn the whole body of the carriage—poised on the two pivots—right over them, and in the same line. It is supposed that by this plan, as the body of the carriage is not built upon the frames, but rests upon them at two central points, or small circles only, the jerking arising from inequalities on either side of the railway will be done away with, or at least rendered scarcely perceptible. Another obvious advantage, we should think, is, that that in any rapid curves of a line, the wheels are not liable so get over the rails, as the plan involves what is equivalent to a hinge in the middle of frame-work, so that the whole is easily turned, as a lorry or omnibus. The principle is not precisely new, for it has been applied in a ruder manner, for the conveyance of long balks of timber ; but in this case two distinct pivot carriages are employed, and may be placed at any convenient distance from each other.—The first lines undertaken on the other side of the Alps, and which are now open for traffic, are the Milan line and that of Naples. Various important projects have been recently set on foot, and the work of improvement is proceeding with great activity. Three grand Government lines are now being deliberated upon—the Genoese line, the Turin line, and the Lago Maggiore line. These will connect the metropolis of the Italian States with the sea, with Switzerland, and Northern Italy. For communication with Lombardy it will be necessary to extend the Milan line, above alluded to, as far as Tesin. It is also proposed to connect Savoy with Piedmont by tunnelling the base of the Alps immediately contiguous to the defile of Mont Cenis.—The bridge across the Dublin-road of the Great Southern and Western railway in Ireland is a singular work of art. Tha abutments to two of the opposite acute angles are 43 degrecs, and consequehtly 47 degrees from the right angle or square. The formation of this singularly oblique arch commenced at these opposite angles, and continues on in spiral courses until they meet, when the last spiral courses will form the keystones of the whole arch.—The Admiralty have finally settled the terms on which the Grand Junction Company are to be allowed to carry their line across the Mersey at Runcorn. As conservators of the river they require that the bridge, if built on arches, shall have waterway openings of 280 feet in the clear, and a clear headway of 100 feet under the centre of the arches ; but if flat girders should be substituted for arches, 250 feet clear between the piers will be sufficient. A turret staircase is to be erected to facilitate the warping of large vessels through the bridge, and other works are specified, amongst which are the removal of the island between the Castle Rock and the Old Quay Canal, and of a large portion of the rocky share on the Lancaster side and part of the Castle Rock on the Cheshire side with the erection of a curved wall or weir for 2,000 feet eastward, and if necessary, 800 feet further.

ENGINEERING.

*Bursting of the Union Canal.*—An Edinburgh paper states, that recently two portions of the embankment of the Union Canal gave way, to the serious injury of some of the adjacent property. The first of these places was at Ratho, and it was first discovered shortly after 5 o'clock in the morning, when the gap was only about two or three feet square; but as the rush of water was great, it soon increased to a chasm of about 20 feet deep and 30 in width. The embankment at this part is of considerable depth, and when the water had fairly forced a passage, in a few minutes the contiguous fields were completely flooded, and left covered with sand and other *debris*. The flood subsequently flowed into the Gogar burn, which it swelled to a great extent, and caused the submersion of numerous fields along it course. A similar event took place about the same time at a part of the canal to westward of Linlithgow, and near to a viaduct over the Avon. The mass of embankment which gave way at this point was even larger than that at Ratho; but it appears the damage which the water committed was not so extensive, as it soon found a channel in the Avon. The causes which led to these occurrences, so far as could be gathered, were of a twofold kind. It seems that at Linlithgow, the water of the canal, to a considerable distance, has lately been drained off, in order that some improvement might be made. This act had accumulated the water into less than its usual space, and the immense quantity of rain which fell on the night hastened the catastrophe.

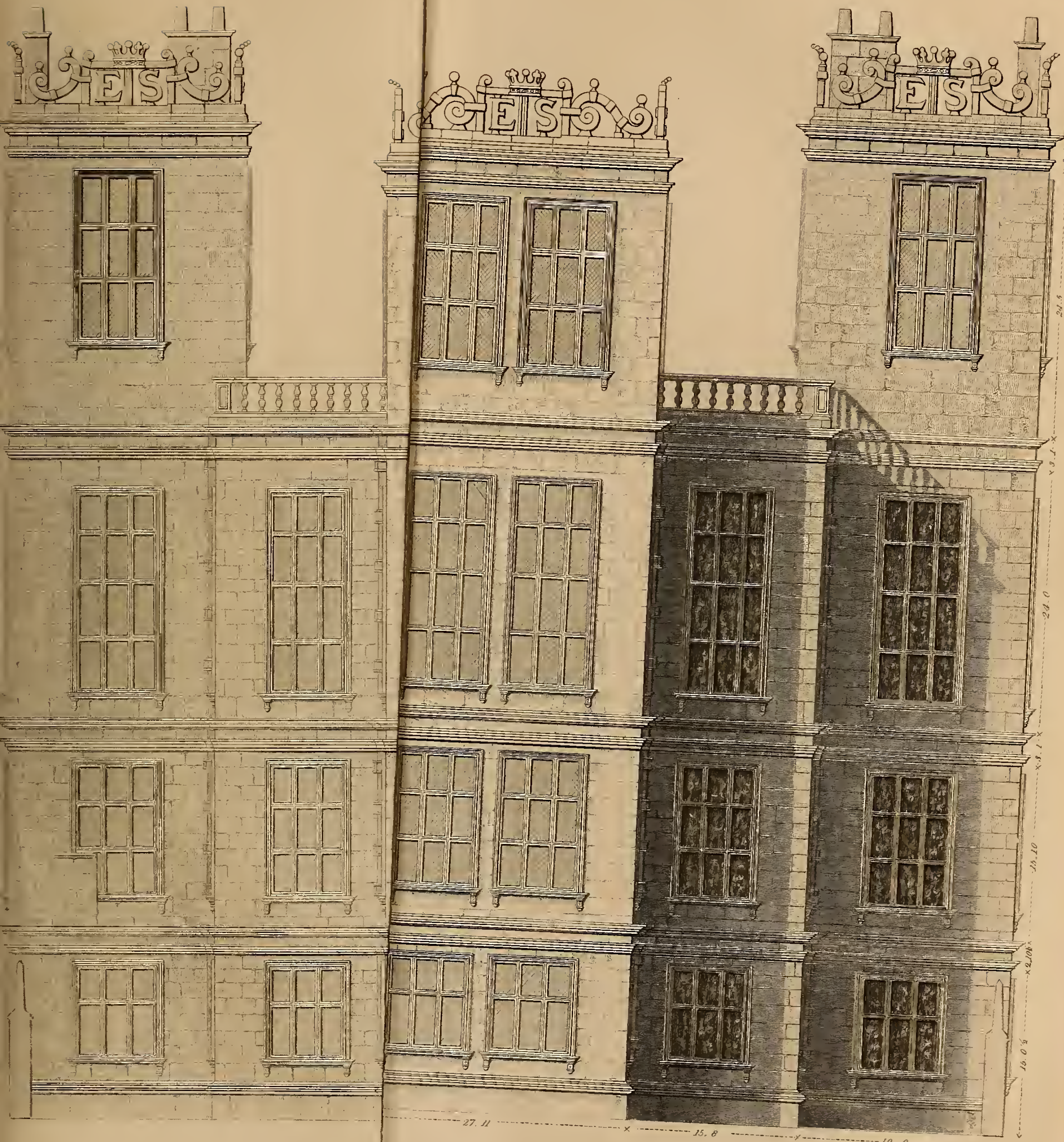
*Steam communication with France.*—The annual meeting of the Commissioners of the Newhaven Piers was lately held at Lewes, when a report from Mr. Walker on the capabilities and means of improvement of the harbour was brought up and discussed. Mr. Walker submitted a plan for improving the harbour at a cost of £150,000, including a provision of dock, wharfage, and berths both for merchant and goverment steamers, with a depth of eight feet at low water spring tides, and from ten to twelve feet at low of the neap. Letters to the Earl of Chichester and Sir H. Shiffner, Bart. were read from Captain Hotham, on the part of the London and Brighton Railway Company, expressing surprise and regret at finding the harbour in the same state as when he visited it twelve months before, since a Company, springing out of the Brighton Railway Company, had at length determined to establish a better communication with the French coast than that furnished by the General Steam Navigation Company, and were disposed to make Newhaven their port, in order to accomplish which, an improvement of the channel at the mouth of the harbour was indispensable. The Company had already entered into contracts for the construction of powerful steamers to be placed on the station in April next. Captain Hotham, in reply to various questions from the Commissioners, stated that the new vessels would be 150 feet long, with a draught of seven feet; and that on the making of the requisite improvements in the harbour would greatly depend whether the Railway Company would construct the railway to Newhaven, for which they had already obtained an Act. Should this be done, Newhaven would be the principal route of communication between London and Paris; and the voyage from Newhaven to Dieppe, he had no hesitation in saying, would be made in four hours and a half. The result of the discussion was the appointment of the Earl of Chichester and Sir H. Shiffner as a deputation to wait on the Admiralty, with a view of ascertaining whether Government would assist in the improvement embodied in Mr. Walker's plan.

*Docks and Factories at Alt-Ofen.*—There is much bustle at Alt-Ofen on the Danube, under the superintendence of M. Massjohn, an engineer who studied in this country. There are in progress 30 iron barges of 250 tons burden, four iron coal barges, eight barges for the conveyance of cattle, a gun boat for the Austrian government, and 20 moveable piers, with suitable boats. Since 1844 10 steamers, of 1306 collective horses' power, have been constructed by M. Massjohn. The establishment is extensive, and the buildings are fire-proof; the docks occupy about 1200 men. The Danube Steam Navigation Company have 37 passenger steamers, and two goods steamers of the collective power of 3,926 horses. The passenger boats ascend from Pesth to Vienna in 18 hours, and from Vienna to Linz in 17 hours. The draught of vessels of 200 to 250 tons burden is about four feet, which allows them to pass over the sand-shoals

*Fatal calamity in a Cornish mine.*—The particulars of the calamity, by which 40 persons were drowned in a lead mine in Cornwall, are thus given in the *Plymouth Times*:—"On Friday afternoon there was a heavy thunder-storm in Cornwall. A cloud burst when over Newlyn East, about five miles to the North of Truro, discharging its contents in immense torrents of water, on the hills which surround the East Wheal Rose Lead Mine, the shafts of which extend across the valley. In one of these shafts the accumulated water poured when the men were at work beneath. The first notice the men had was the extinguishing of every candle by the force of the wind occasioned by the water coming down the shaft in such a body as to compress the contained air. Even the props of the roof and sides of the mine were snapped asunder, and the walls immediately came together, entombing the poor fellows then at their work. Some who were then at the bottom were saved, whilst others who had got up so near to the surface as to be recognized were driven down again by the force of the immense force of water. Between 40 and 50 are missing. It is said that upwards of 100 children are left fatherless by this awful calamity.

MISCELLANEA.

This summer the banks of the Cam exhibit an unusual multitude of those singular phenomena—cases of spontaneous ignition and combustion in growing willows.—A live toad was lately found by some of the workmen employed in making the tunnel through the mountain in the neighbourhood of Bangor, in a solid rock, eighty yards from the surface, and about the middle of the mountain. It is very large, and was living two hours after it was found.—Five hundred and seventeen barrels of potatoes have just arrived from Bermuda.—In the Town Council of Leeds a motion has been carried by a majority of 25 to 2, for empowering the Street Committee to carry out an efficient system of sewerage, and for placing a sum of not more than £30,000 at its disposal for that purpose.—A contract has just been entered into to supply Madrid with water. An adjudication has been made of 71½ millions of reals for the purpose: the supply will be twenty times greater than it is at present.—In the Duchy of Luxembourg, a well is being sunk, the depth of which surpasses all others of the kind. Its present depth is 2,336 feet, nearly 984 feet more than that of la Grenelle, near Paris. It is said, that this immense work has been undertaken for working a large stratum of rock salt.—The general paving of the Boulevards, in Paris, is nearly completed. The next great work will be the approach to the bridge de la Concorde, and the levelling of the earth, which is now in work. The paving of the Place du Caroussel will be completely remodelled in a very short time.—The Sultan has created a Ministry of Public Instruction in Constantinople.—Letters from Naples announce that Vesuvius is in full eruption—throwing out masses of lava, and illuminating the heavens.—It appears from the last annual report of the American Commissioner of Patents, that the number of Patents applied for in 1845 was 1246, and number issued 502, making the total number of patents granted by the United States since the establishment of their independence up to January of the present year 14,526.—The Belgian papers state that the Treaty of Commerce between Holland and Belgium was concluded and signed on the 4th July.—It is stated from St. Petersburg, that news had been received from the interior of Russia of a tremendous hurricane along the banks of the Wolga, which destroyed between 100,000 and 150,000 chetwerts of flour, rye, wheat, linseed, &c., which were destined for St. Petersburg. The loss is very great.—A silk manufactory has just been established in Bruges, by M. Grosse. Only black silks will be manufactured there.—A new Institution for the medication of milk has been lately established at Montrogue, near Paris. The physicians who superintend it propose to treat certain classes of patients with the milk of goats and cows, after having placed these animals on a system of medical treatment adapted to develope in the milk those therapeutic qualities which may be requisite for the treatment of particular diseases.—The powder mills of Cartoun, Alexandria, have blown up—they contained 1000 quintals of gunpowder. Two hundred persons have perished.—A Government bill has been printed to amend the act 7 and 8 Victoria, cap. 73, and to give effect to a treaty concluded between Her Majesty and the King of Prussia, for the purpose of securing to the authors and publishers of the United Kingdom, and of the dominions of Prussia, respectively, a reciprocal protection in their rights of property in their productions. The rate of duty is set forth in the schedule annexed to the act. Books originally produced in the United Kingdom and republished in the country of export, are to be charged 2*l.* 10s. the cwt., and works not originally produced in the United Kingdom 15s. the cwt. Prints and drawings (plain or coloured) ½d. each, and bound or sewn 1½d the dozen.—It having been stated to the Lords Commissioners of her Majesty's Treasury, that by an error in the printing of the Act 9 and 10 Victoria, cap. 23, manufacturers of silk, of and from a British possession, are made chargeable with a higher rate of duty than that intended by the Legislature, the Commissioners of the Customs Department have received a communication from the Secretary to the Treasury, to the effect that he had been commanded by their lordships to desire that the Board would give directions that manufacturers of silk, or of silk mixed with any other materials, of and from a British possession, may be charged with the duty of 5 per cent. for every 100*l.* value, as intended by the resolutions of the House of Commons, signified to the Commissioners in their Lordships' order of the 18th of March last, and that their Lordships further desire that in any future Customs Act they will cause this error to be corrected.—Immense swarms of locusts this year infest Tennessee. They are said to be of a species which appears but once in thirteen years, their last advent being in 1833, the year of the cholera, when they have the letter C on each wing; this year they had an ominous W. The noise they make is compared to the continuous roll of thousands of drums. They do no damage, but after laying their eggs in the trees, die; and the ground is already covered with their remains. It is said that the eggs produce worms which, falling to the ground, burrow there, and remain for thirteen years, when they issue forth as locusts, making holes for their ascent through the earth, and even through brick pavements when they stop their way.—To prevent poison, from the accidental or wilful administration of arsenic or other poisons, the following device has been suggested:—Add five grains of sulphate of iron (green vitriol), or sulphate of copper (blue vitriol), with ten grains of ferocyanide of potassium, to every drachm of arsenic sold in a druggist's shop; and the consequence would be, that on mixing the poison with any liquid whatever, it would directly turn blue, black, or red, and become an immediate object of suspicion to the party to whom it was presented.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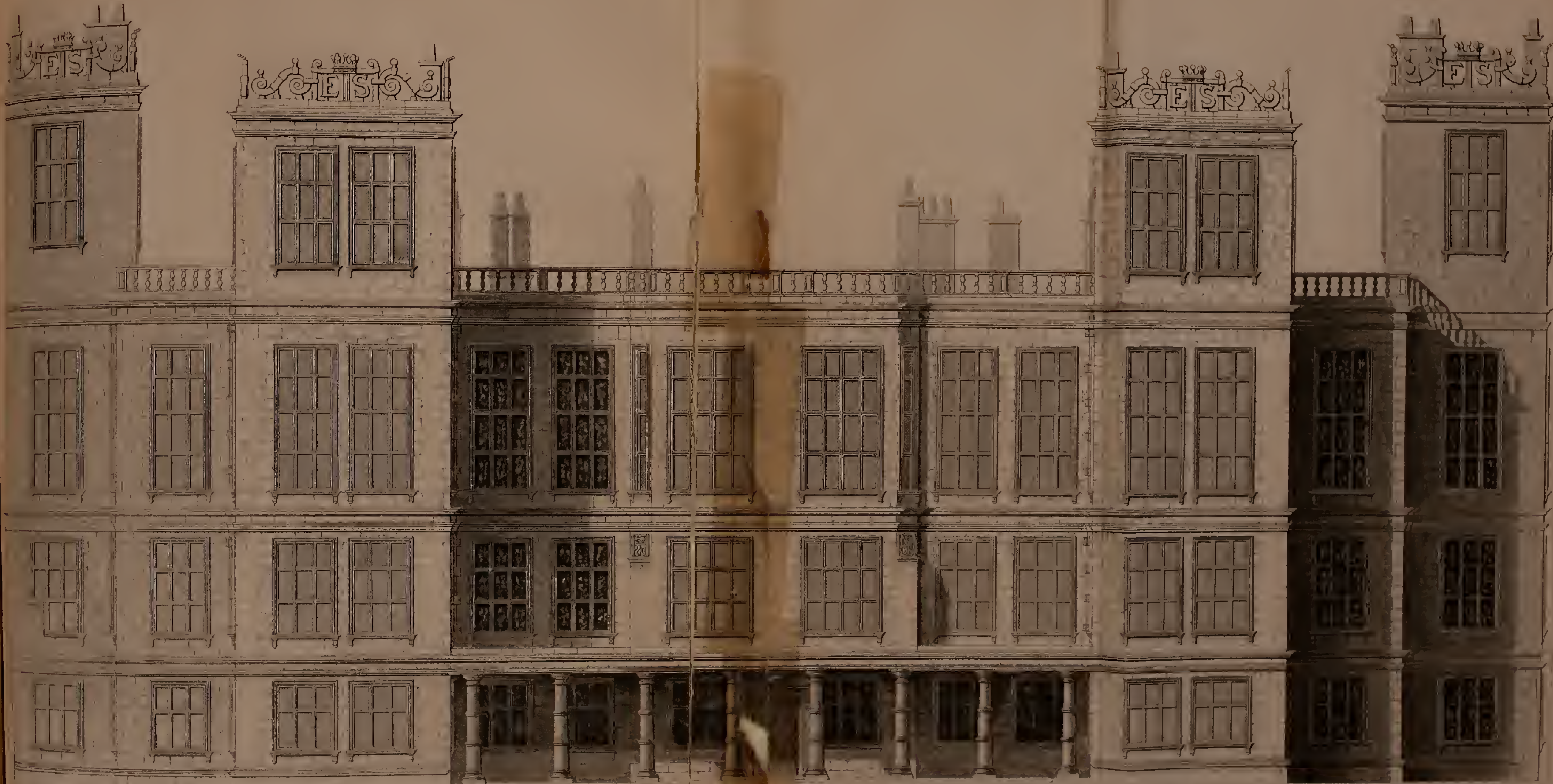


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# THE ARTIZAN.

No. XXI.—New Series.—SEPTEMBER 1st, 1846.

## Art. I.—RAILWAY SPECIFICATIONS.

The practice of engineering is most effectually learned in its specifications; and, as there is at the present moment a large influx of novices into the domain of railway engineering, we believe that a selection of approved railway specifications will be widely acceptable. Our first specimen will be one that comprises most of the kinds of work involved in the construction of railways: we shall hereafter give specimens of specifications for such works as are difficult or peculiar.

*Form of Tender.*

To

The Directors of the London and South Western Railway Company.

Gentlemen,

the undersigned

living at engage to execute the railway with cuttings, embankments, brickwork, masonry, bridges, culverts, sleepers, drains, fencing, gates and other works complete, including the ballast and sleepers, and the laying of the permanent road, and to furnish all labourage and material necessary for the entire completion of the same, excepting the rails and chairs, according to the plans, section, drawings, specification and conditions exhibited to the contractors at the office of the Company's engineer, and to repair and uphold the said railway and works for the space of one year after their entire completion for the sum of £

And bind likewise to execute all extra works, which may be required by the Company's engineer, according to the schedule of prices annexed hereto, or of those contained in the detailed estimate, and agree to a reduction from the above sum according to the same for all works which may be reduced or suppressed.

*Schedule of prices referred to in the Specification.*

| | | £ | s. | d. |
|---|---|---|---|---|
| 1. | Excavation and embanking, at per cubic yard, | | | |
| 2. | Soiling slopes, including stripping and re-spreading, at per superficial yard, | | | |
| 3. | Stone for bridge copings, including dressing and setting, at per cubic foot, | | | |
| 4. | Brickwork (common bricks) in mortar, in bridges, culverts, or walls, including centring, scaffolding, pointing, and cutting foundations, at per cubic yard, | | | |
| 5. | Concrete 3 parts sand, 3 parts gravel, and 1 part lime, set in place, at per cubic yard, | | | |
| 6. | Fencing, including the posts, rails, quicks, quick mounds, ditch, &c. at per lin. yard, | | | |
| 7. | A pair of gates, according to drawing No. 10, fig. 4, including posts, iron-work, and fixing, at per pair, | | | |
| 8. | Laying and ballasting permanent road, with the rubble and tile drains complete for one road, at per lineal yard, | | | |
| 9. | Wooden sleepers, each, | | | |
| 10. | Spikes, per ton, | | | |
| 11. | Culverts, including foundations and walls at the ends: | | | |
| | 18 inch culvert, according to drawing No. 1, fig. 9, at per lineal yard, | | | |
| | 2 feet culvert, according to drawing No. 1, fig. 8, at per lineal yard, | | | |
| | 3 feet culvert, according to drawing No. 1, fig. 7, at per lineal yard, | | | |
| | Double 3 feet culvert, according to drawing No. 1, fig. 10, at per lineal yard, | £ | s. | d. |
| | Memel timber, framed in whole balk, including Kyanizing, at per cubic foot, | | | |

SPECIFICATION OF THE LONDON AND SOUTH WESTERN RAILWAY (SALISBURY BRANCH) CONTRACT.

*Extent of contract.*—The contract to which this specification refers extends from

*Formation and maintenance.*—The contract will consist of the formation for 12 months of all the work on this part of the line—the erection of all the bridges, culverts, and fencing, the labourage and materials required for these, (including scaffolding and machinery,) and for excavating, embanking, pumping for foundations, draining, laying rails, ballasting, and forming the railway. The contractor shall also procure all the bricks, stone, timber, mortar, iron work, blocks, sleepers, ballast, and every other thing necessary for entirely completing the works, the Company undertaking to procure the permanent rails and chairs, and the land upon which the railway, side cuttings, and spoil banks are to be made.

*Liability of contractor for damage.*—The contractor is required to guarantee the stability of all the works, and to be liable for all risks and accidents to which they may be subject while in progress, and for 12 months after their completion. He is also to make compensation to the owners and occupiers of land for all the damage they may sustain from trespass, or by imperfect fences, or from water by the stopping of the regular channels, or by any other means.

*All the works included, although only parts shown.*—The principal part of the work to be done is described in this specification, and shown on the accompanying plans and drawings, but it is to be distinctly understood that all the works, although only parts of the same may be shown on the plans, sections, or drawings, are to be considered as included in the contract, and their value comprised in the sum tendered, as much as if such work had been fully described in this specification; and also that such works as may be mentioned in the specification and not shewn on the plans, sections, or drawings, are to be included in the contract, the same as if shewn on the plans; in short, the contractor is to execute all the works necessary for the entire completion of the line, for the length stated, and to finish the same with good and approved materials, to the full satisfaction of the Company's engineer, and of his deputies and assistants.

*Contractor must satisfy himself as to accuracy of plans, &c.*—The plans and sections to which this specification refers are supposed to be correct, but the contractor must satisfy himself on this point by taking levels or by any other means, as no allowance will be made, or any addition to the contract sum, on the ground of any mistake. The number of cubic yards in the embankments and cuttings is ascertained by taking the depth on the centre line of the railway, the accuracy of which the contractor must ascertain for himself, and his attention is hereby directed to the transverse sections of the land, for no allowance will hereafter be made on the ground of error, whether real or supposed. Neither in the statement of quantities is any allowance made for the consolidation of the embankments; the contractor will therefore, in the first instance, make such allowance as his experience may suggest, for no allowance beyond the contract sum will be made.

*Temporary fences and occupation gates.*—All temporary fences or gates, or other provisions necessary for the accommodation of the property passed through, and for the prevention of trespass and injury, and for the maintenance of the drainage of the same during the progress of the works, must be made by the contractor, who shall be liable for all the damage caused by the neglect of such provisions and precautions.

*Spoil banks.*—Wherever the engineer shall deem it desirable to make spoil banks, the contractor shall, immediately on the land being procured for him, cause a good and substantial fence to be made (and kept in good repair,) so as entirely and effectually to fence off from the adjacent lands, the piece of land upon which the spoil bank is to be made, and he shall remove from the said piece of land the whole of the soil, which he shall effectually preserve; and after the spoil hank shall have heen made, he shall properly level, drain, and slope the same to an inclination of six feet horizontal to one foot perpendicular, after which he shall re-soil the whole, and make them fit, in every respect, for the purposes of cultivation, and he shall restore the fences and drains to their former state, or as nearly so as may he.

*Setting out works.*—The contractor shall provide the engineer or his assistants with lahourers and tools for marking on the ground the width of the cuttings, embankments, and fences, and for setting out the hridges, measuring or setting out all or any of the works, and shall provide stakes, staves, poles, or marks for these purposes.

*Railway to be fenced before work commences.*—The contractor shall, immediately on taking possession of the land, cause a good and substantial permanent or temporary fence to be erected on each side of the land required for the railway and works, until which be done, no soil or earthwork of any description, nor for whatever purpose, shall he dug or removed, and gates or slip rails shall he placed in these fences for the convenient occupation of the adjacent lands, and wherever the cross fences shall he stuhhed up for facilitating the cartage of materials along the line of the said railway or for other purposes, there shall he erected gates or slip rails for the more effectual prevention of trespass.

*Centre line.*—On the plan the centre line of the proposed railway is descrihed by a red line, and this line corresponds with a line of stakes driven into the ground at intervals of 22 yards, or thereahouts.

*Section.*—Along this line, and at these stakes, the levels have heen taken, and the undulations of the ground are described hy a shaded black line in the accompanying section, but it is understood that the contractor will satisfy himself of the correctness of this line, and of these levels, as no allowance will hereafter be made for any real or supposed error.

*Line of rails on section.*—The surface of the rails on the section ahove referred to, is indicated by a blue line, and to which the description of the various inclinations in the Appendix, page , refers.

*Formation level.*—The red line, which is drawn parallel to the hlue line, and at a distance of feet from it, represents the level to which the cuttings and emhankments are to be formed previous to receiving the material for forming the roadway. This space is to be filled up by the ballast, hlocks, sleepers, rails, and chairs, in the following proportions, viz.:—the ballast under the blocks to he thick, and under the sleepers thick, the blocks thick, and the sleepers thick, and the rails and chairs inches.

*Cross section of railway.*—All the embankments must he made not less than feet wide at the top, with slopes in all cases of feet horizontal to feet perpendicular. Upon this the ballast is to he laid, and the whole shall be finished off according to the form and dimensions shewn on the drawing No. , fig. .

The above dimensions refer to the embankments when permanently finished, hut the contractor shall, in the formation of the banks, allow sufficient space for settlement, so that when completed, and handed over to the Company at the expiration of the contract, they may remain of the full width ahove prescrihed.

*Cuttings.*—The cuttings shall he made feet wide at the hottom or level of the red line on the section, with uniform slopes of feet horizontal to feet perpendicular, subject, however, to such special exceptions as are marked on the accompanying section.

*Engineer has power to vary the slopes.*—If at any time it shall appear to the engineer advisable, in order to facilitate the works, or otherwise for the more effectual consolidation of the material, or for the prevention of slipping, to make the cuttings of a less width than feet, or of a less depth than is represented on the section, or to leave the sides or slopes of the cuttings standing, or to proceed with the embankments at a less width than feet, or at a less depth than is represented on the section, he, the said engineer, shall have full power to cause the same to be done, and the contractor shall implicitly follow his directions in this as well as in all other matters, and he shall remove the remaining earth, or complete the remainder of the work, when the engineer shall direct, without any extra charge.

*Soil to be preserved.*—The whole of the soil, or such portions thereof as as may be necessary for planting the quicks and soiling the slopes four inches thick, shall be first taken from the surface of the ground where the cuttings and embankments are to be formed, and placed on the sides thereof at convenient practicable distances. This soil shall he carefully preserved for planting the quicks, re-soiling the slopes of the cuttings and emhankments, and for such other purposes as the engineer shall direct.

*Materials on the line, the property of the Company, to be preserved.*—All the walls, hedge-rows, stumps, stiles, timher, trees, &c. that are to taken down or felled in or on the line of the said railway, or in the cuttings, shall he done at the expense of the contractor, who shall employ proper and experienced persons for that purpose, and shall, if required by the engineer, peel and stack the hark from any such trees, and place the whole by the side of the said railway or other convenient station, and shall effectually preserve the same, and every other article and thing that may thus or in any other manner hecome the property of the Company.

*Drains in cuttings.*—In all the cuttings a drain shall be made on each side of the roadway, the bottom of which shall he six inches helow the lowest part of the ballast. It shall he finished according to the form and dimensions represented in the drawing No. , fig. .

*Fencing.*—A permanent fence shall be made on each side of the railway, throughout its whole extent, with good oak or larch posts, placed not more than three yards apart, and three-split oak, or sawn larch, or fir rails, with a standard of split oak or larch in the middle of each length of rails. The posts shall not be less than 5 inches hy 2½ inches in their smallest dimensions; they shall he 6 feet long, and have 2 feet hold of the ground. The rails shall have a section of at least 6 square inches, and shall not he less than 2 inches in thickness at the smallest part. The standard shall not he less than 4 inches by 2½ inches, and shall he driven 18 inches into the ground, being placed midway between the posts, and firmly nailed to each of the rails. Each rail shall he properly scarfed, and have a projection through each post of not less than 3 inches.

*Drains outside railway fence.*—Without this fence, and on each side of the said railway, throughout its whole extent, shall he formed the ditches or drains, the top width of which shall be on an average 3 ft., the depth 1 ft., and the width at the bottom 1 foot. These dimensions, however, will vary according to the nature and level of the ground, and in order the more fully and effectually to prevent the lodgment of any water, the contractor shall in all cases so form the said ditch or drain, that it shall be of sufficient depth to free the cross tile drains and ditches of the adjacent land, and that the water shall run freely to the next or nearest outlet, culvert, watercourse, or bridge; and he shall at all times keep the said ditch or drain free and open, so that no overflowing of its hanks or sides can take place, nor any injury he done to the slopes of the cuttings or other works connected with the railway or the adjoining land.

*Quick mounds.*—Within this ditch or drain, and at the distance of one foot therefrom, on each side side of the said railway, throughout its whole extent, is to he raised the mound for the quick horder, one foot high on a base of 3 feet, formed and banked up hy the soil or turf cut out of the side drain. Within this mound shall he dug and formed a quick border 2 feet wide and 2 feet deep, which shall he filled with the very best of the soil, and planted with a double row of good 4-year old white thorn quicks that have been transplanted two years out of the seedlings' hed. 12 sets shall be placed in each lineal yard.

*Quicks.*—As much as possihle of the quick fencing shall he planted from November next to the month of March or April in the ensuing year; and if, during the period assigned for making and maintaining the works herein specified, any of the quicks, quick horders, mounds, posts, rails, ditches, or other works required to he done, shall have heen decayed, destroyed, thrown down, or removed from the proper line of direction as marked out by the engineer, the contractor shall replace them, and make up all deficiences, and repair whatever damage may have been done from whatever cause, in the same manner as when first made.

*Cross fences to be restored and joined to railway fence.*—Wherever the the line of railway cuts through cross fences, or where the adjacent fences are destroyed by spoil banks or otherwise, the contractor is required to form a quick mound with soil, and planted with quicks in the manner described for the quick fence hy the sides of the railway, and to erect a row of posts and rails on each side of the said quick border, so as to make a perfect and continuous fence, properly united and joined to the fences hy the sides of the railway; and wherever a cross fence joins or unites with the quick fences on the side of the railway, the passage hy the side ditches, already described, must he preserved free and open by inserting a short 18-inch culvert under each of these cross fences, or by other sufficient means.

*Slopes to be soiled.*—Whenever it may he deemed by the engineer expedient to slopes of the cuttings and emhankments, whether during the progress of the works, or when they are completed, the contractor shall lay a stratum of soil 4 inches thick upon the whole surface of the slopes of the cuttings and embankments, and the whole of the slopes shall, previously to the soil being laid on, be neatly and uniformly dressed to the several angles or slopes hereinhefore described, and when the soil is spread, the whole shall he sown with grass and clover seeds, and shall he properly and neatly maintained for the full period of the contract.

*Borings.*—Borings have been made on various parts of the line, and the contractor may see the account, but he must satisfy himself of its accuracy, as the Company will make no allowance should the material differ from that stated in the account.

### GENERAL REMARKS AS TO MATERIALS AND WORKMANSHIP REFERRING TO ALL BRICKWORK AND MASONRY.

A list of all the bridges on this contract, together with a particular description of each bridge, will he found at page of the Appendix; but to avoid repetition, the following remarks, which refer to all hrickwork and masonry, are here given.

*Bricks.*—All bricks used in the interior of the bridges shall he good, hard, sound, and well burnt, and, unless made a year before they are used, shall be well saturated in water.

*Quality and description of brickwork.*—The hricks shall he laid in English or Flemish bond as the engineer shall direct with a mallet in well tempered mortar. No joint shall exceed ¼ of an inch in thickness (or as close as the nature of the bricks will permit), and every course shall be well grouted. No broken bricks shall be used in any of the arches or walls, except what may be required for closing a course, and the work shall be equally good for the interior as for the exterior of the walls. The underside of the arches and the exterior of the walls shall be neatly and effectually pointed. In all battering walls, whether curved or straight, the beds of the bricks shall be laid at right angles to the plane of the exterior battering line.

The bricks used in culverts shall be good, sound, and hard burnt, and moulded to the forms to suit the different sized culverts.

*Stone.*—The stone used shall be hard and sound, and free from backs, beds, shuds, or any flaw whatever, and in each bridge shall be of uniform colour.

*Mortar.*—The mortar shall consist of the best lime, and of clean sharp sand, and shall be well mixed together in such proportions as the engineer shall direct, either by treading, or in a pug mill.

*Water, lime, and cement without extra charge.*—If in any situation the engineer shall deem it necessary to use cement or water lime, the contractor shall provide it without any extra charge.

*Masonry to be tooled.*—The quoins and arch stones shall be well and truly bedded and squared throughout, and no pinning will be allowed. They shall have rustic joints of 2 inches, and be neatly tool-dressed. The impost string course and coping shall also be neatly tool-dressed.

*Bad materials to be removed from the works.*—Any stone, bricks, or other materials which the engineer shall think unfit for the purpose to which it is proposed to apply them, shall be removed from the work by the contractor within 24 hours after the receipt of a written notice to that effect from the engineer or his assistant, and in place thereof proper and efficient materials shall be supplied.

*Foundations.*—The foundations for all the bridges over, or walls adjoining to the railway, shall be laid not less than 4 feet below the blue line on the section or permanent level of the rails, and of the wing walls not less than 18 inches below the proper line of the slope, or of the natural surface of the ground, except where it is expressly stated to the contrary. For the bridges under the railway, the foundations shall be laid at the levels shown in the drawings. If, however, at any of these depths the ground be considered by the engineer too soft or insecure to build upon, the said ground shall be excavated to such depth as the engineer shall direct, and the space so excavated shall be built up with concrete, stone, brick, or other solid material fit for the purpose, and the foundations for every bridge shall be inspected and approved of by the engineer before the superstructure is commenced.

The above stipulations apply to all ordinary contingencies of ground in the foundations, but if in any special case (and from unforeseen causes) it shall be found that considerable expense is entailed on the contractor by the necessary precaution in obtaining good foundations, then in such case an extra sum will be allowed, on the certificate of the engineer, at the price for similar work in the detailed estimate or schedule.

In all cases the parapet walls of the bridges shall have the same inclination as the approaches, and the top width of the approaches shall be at the least 6 feet more than the width between the parapet walls of the bridges.

*Bridges of less height than specified to be pulled down and rebuilt.*—In every instance there shall be, when completed, at least 15 feet 6 inches (or more, where shown on the drawing,) clear height from the level of the permanent rails to the level of the underside of the arch, and the contractor shall make such necessary allowance for settlement as to secure this clear height, and any bridge that is of less height when finished, shall be pulled down and rebuilt at the expense of the contractor. The string course shall not be set until at least a week after the centres are struck, and no centres shall be eased, struck, or removed from under any arch without due notice to the engineer, or his assistants or inspectors.

*Care to be taken in forming embankments not to injure bridges or culverts.*—In forming the embankments across the arches of all the bridges under the railway, as well as over the culverts, great care must be taken to prevent any of the brickwork being displaced or damaged, for which purpose the contractor shall carry up the embankment equally on both sides of the arch in thin layers, which shall be well and properly pounded and beaten, and the arch shall be loaded uniformly along its whole extent. And the contractor is hereby expressly forbidden to bring forward any embankment on one side of an arch, until the opposite side shall have been backed up and pounded in such a manner, as shall effectually preserve the arch and walls in their true and proper shape.

*Removal of centres, style of finishing earth round bridges, &c.*—All the bridges and walls shall be properly pounded and backed up, and the approaches made uniformly on both sides, until which be done, in addition to the precautions before required, the centering shall not be removed, nor shall the parapet walls be built until after the roadway shall have been formed over each bridge. The slopes of the embanked approach roads on the outside of the wing walls shall be well rammed and pounded, and carried up in thin successive layers uniformly with the backing between the walls, and the slopes of that part of the approach road which adjoins to the bridge or comes within the outer fences of the railway, shall be ramparted with sods, so as to form with the cutting an uniform slope by the side of the wing walls.

The extrados of the arches shall, where required, be covered with a layer of well tempered puddle.

### CULVERTS AND BRIDGES.

*All the culverts and bridges to be included in the tender.*—All the culverts and bridges marked on the section are to be included in the sum tendered, but, in addition to this, the contractor is to give in a price for each description of culvert and bridge figured in drawings No. , which price is to include the cutting out the foundations, the walling of the ends, and all scaffolding, centring, &c.

*Foundations and backing of earth.*—In cutting out the foundation of these culverts, should the ground be found too soft or insecure to build upon, the said ground shall be excavated to such a depth as the engineer shall direct, and the space so excavated shall be filled up with concrete or rammed down with clay or other material, such as the engineer shall approve of, and when the culverts are turned they shall be backed up with good sound earth or clay, and well beaten with a double-handed beater, so as completely to cover them, and secure them from changing their shape.

*Length and direction of culverts.*—The lengths of the culverts will depend on the situations in which they are to be placed, in some cases being at right angles, and in others oblique to the line of the railway, but every culvert (excepting such as are herein expressly directed to the contrary,) shall be built as nearly parallel to the old brook course as practicable, and shall be made sufficiently long to pass completely under the slopes of the embankment (the angle of which has been before described) to the outer sides of the fences to be made on each side of the railway, and the wing walls to every culvert shall be sodded over and covered with soil, in order that the quick fences may grow thereon. And in all cases where a culvert does not pass in the direction of the brook course, (or where it may be necessary to divert the brook course and carry it by the side of the railway to the two extremities of the culvert,) the said brook course shall be cut of the same dimensions as that so to be diverted or changed, and in order to prevent any washing or injury being done to the banks at the end of the culvert, a short return wall shall be built so as to guide or direct the water into or from its original course.

*Water to be kept off railway.*—Wherever in cutting through a brook or drain, the level of the railway, or of the small ditches on the sides of the railway, shall be lower than the said brook or drain, then, in order that the water may not flow upon the railway or by the sides thereof, an outfall or level shall be brought up of such a depth as that the water may flow freely by means of a culvert under the railway, without changing the course (otherwise that by deepening the bed) of such brook or drain. This, however, will only be required when the brook courses may not be changed, or when the side ditches, already directed to be formed at the outer sides of the fences, cannot conveniently be made to carry off the water. In all cases, however, the contractor shall, either by the method just described, or by that described heretofore, prevent any water (except what, in the engineer's opinion, is absolutely unavoidable,) from coming upon the railway so as to injure the ballast or the foundations of the road, bridges, or other works connected with the railway; and he shall also prevent the water from backing up the ditches or flooding the adjoining lands.

### FORMATION OF SLOPED OR APPROACH ROADS.

*Ascents and descents of roads.*—When occupation roads, or any other road, whether public or private, shall cross the railway by means of bridges, or on the level thereof, or pass by the sides thereof, whether at the places indicated on the map or section, or at any other place or places hereafter to be fixed upon, the same, where required, shall be cut down, banked up, and formed by the contractor, and the ascents and descents to each shall, in the case of turnpike roads, not be steeper than , for public highways , and for occupation roads , and the slopes of the excavated or embanked sides shall in all cases be formed at the rate of 1½ foot horizontal to 1 foot perpendicular, unless otherwise directed by the engineer.

*Width of roads.*—The width of these roads, whether excavated or embanked shall, for turnpike roads, be 30 feet, for public or township roads 20 feet, and for occupation roads 16 feet, clear of the ditches and fence mounds, and at the top or bottom of the slopes, (as the case may be) 18 inch drains shall be cut, and (if such be considered necessary by the engineer) culverts of the same size shall be made under the railway, so as to preserve uninterrupted water courses by the sides of such roads so crossing the said railway.

*Draining and metalling.*—The whole of these roads, whether public or private, shall be well under-drained by diagonal drains filled with broken stones, and the whole of their surfaces covered with a coating of good stone or gravel, (no piece of either of which shall be greater than 2 inches in diameter, and not less than 12 inches in thickness,) and at every crossing on the level a pitched pavement shall be laid extending across the railway to the fences on the sides thereof, and for the full width of the road, and there shall be placed and firmly fixed, at the distance of 2 inches from the rail, a curb of iron, wood, or stone, on each side of the 4 rails, and parallel thereto.

*Culverts under approaches for side drains.*—Wherever in the crossing of occupation roads or other public or private roads, whether by means of sloped approaches or otherwise, the ditches which are herein specified to be made by the sides of the railway, or by the sides of the embankments, shall be crossed or intersected, a free and uninterrupted water course shall be left by means of two 18-inch culverts built under each and every such road.

*Temporary roads.*—Before any public or private road shall be disturbed for any of the purposes herein required, or for any other purpose, the contractor shall make a good and sufficient road, as near thereto as practicable, or as the case may require; and shall, to the satisfaction of the surveyor of the road, keep the same in good repair, so as to prevent any inconvenience or obstruction to the free passage thereon, until the bridge or approaches (as the case may be) for the new road shall be fully completed, which must be within the time specified in the act of parliament.

*Formation of new road, and restoration of old road to land.*—The making and maintaining these roads, whether private or public, shall be to the satisfaction of the engineer, and the surveyors of the highways, or of the surveyor of the turnpike road for the time being, and the contractor shall also make and maintain, to their satisfaction, all such soughs, drains, or watercourses, as may be needful or necessary during the execution of the work, and shall provide and maintain all gates and fences, and shall extend, alter, and remove the same according to circumstances, and shall be held responsible for all damage that may be done to the lands or ground in the execution of any of the said roads, and he shall (having first fenced off and completed such temporary road) remove all the stone, gravel, or metalling upon each private or public road, and cause it to be laid aside, and after such road be cut down, raised up, or the bridge built (as the case may be), the said stone or metalling, with such additional quantity as may be required, shall be re-spread in the manner and proportions already described, and the ground upon which such said temporary road or side road shall have been formed shall then be restored to its original state, and the fences made perfect and joined to the fences, which shall in all cases be made on each side of such newly formed road. These fences shall be made either at the top or bottom of the slopes or sides, as the engineer shall determine, and shall correspond with the fences specified for the sides of the railway; and on every road which shall have been broken up, raised, lowered, or disturbed for any of the purposes herein specified, the contractor shall, to the extent which such road shall have been so disturbed, maintain and uphold it in a proper state of repair, to the entire satisfaction of the engineer and surveyor of the road, for the term of this contract.

*Necessary alterations of bridges and culverts adjoining railway included in contract.*—If, by the lowering or raising of any road, it shall be found necessary to lengthen, alter, or vary any culvert or bridge that may pass under any such road for conveying any brook or stream, or for any other purpose, the contractor shall cause such alteration or addition to be made, so that the road, culvert, or bridge may be as effective, and the water flowing thereunder may have the same uninterrupted passage, as shall have existed previously to such road being changed.

When any public road shall be crossed on the level of the railway, gates shall be provided on each side of the road, or of the railway, as the case may require. These gates, together with the railing necessary for joining the railway fence, shall be of the form and dimensions shown on drawing No. , fig. . They shall be formed of good heart of oak, or of the best Memel timber, and shall be fitted up and fixed with the necessary iron work complete, and shall then have three coats of white paint. The number of these gates will be found in the Appendix, page .

PERMANENT ROAD.

*Trimming of bottom for ballast.*—After the cuttings and embankments shall have been completed, and the temporary roads taken up and removed, then shall the bottom of the cuttings and the top of the embankments be levelled down, and brought to the proper height (with the uniform inclinations described in the Appendix, and represented by the red line on the section,) for receiving the ballast, ashes, sand, broken stone, or gravel, upon which the blocks and sleepers are to rest.

*Ballast.*—Should it so happen that no material which shall be considered by the engineer fit for ballasting the road be found in the cuttings, in the progress of the works, or in case of a deficiency of such material, whether in quality or quantity, the contractor shall procure and collect gravel, brick rubbish, cinders, sand, or other dry substances, or he shall procure good hard stone, which shall be broken into pieces not larger than 2 inches in diameter. These materials, being free from clay or other improper substances, (and being first approved by the engineer,) shall be spread over the surface of the cuttings and embankments from one end of the line to the other.

*Laying blocks.*—In all the cuttings where stone blocks are to be used, the ballast, ashes, sand, broken stone, or gravel under the blocks shall be not less than one foot in thickness, and on the embankments, where wooden sleepers are to be used, $19\frac{1}{2}$ inches in thickness (see drawing No ). This stratum shall be well beaten and compressed by means of a heavy roller, or of a block fastened at the end of a spring pole, and made smooth and uniform for receiving the blocks or sleepers. In all cases the blocks and sleepers shall be well beaten down with a wooden mallet, until they rest solidly, and with a full bearing at the proper level. No underpinning or packing up the edges of the blocks or sleepers will be allowed, and wherever they require to be raised, they shall be taken up, and some additional ballast, ashes, or broken stone be put in and well beaten down, and the blocks and sleepers replaced and again beaten with the mallet, and this operation shall be repeated until the proper level is attained. This being accomplished, and after the rails shall have been permanently laid, (the manner of doing which will be hereafter described,) an additional quantity of ballast, sand, or gravel shall be well rammed round the blocks or sleepers to within one inch of their upper surface, upon which shall be spread a stratum of ashes or fine gravel 3 inches in thickness, the upper surface of which shall be raked and smoothed off with a slope towards the ditches or side mounds, as represented in the transverse sections, drawing No. , fig. .

*Ballast drains.*—Between the two roads, and throughout the whole extent of the railway herein described, shall be laid a 3-inch tile drain or a rubble or random drain 1 foot deep and 1 foot wide. This drain shall be formed with stones or broken bricks loosely thrown in, so that the water may flow or percolate through the spaces between them. At every 10 yards shall be formed similar transverse drains, which on the embankments must be carried through the ballast to the edge of the slope, and in the cuttings to the small side ditches. In addition to these shall be formed small surface drains about 6 inches deep, (or more if required) longitudinally and transversely, to free the roadway from surface water. And these ditches, surface and random drains, openings, and culverts and pipes shall be effectually made to the entire satisfaction of the engineer, and they shall be preserved free and open, so as to afford the most perfect drainage of the roadway for the full period of this contract.

*Quality and size of blocks.*—The stone blocks to be used in forming the permanent road shall be hard durable stone, free from crack, flaw, band, joint, vein, or other imperfection, and capable of well resisting exposure to the weather. Each block shall contain 4 cubic feet of stone, and shall be at least 2 feet square and 1 foot in thickness. The most scrupulous attention must be paid to the quality of the stone; it shall be equal in quality to the best kind of

*Blocks in cuttings, sleepers on banks.*—Any block that may crack or split in the drilling or spiking, or that may be discovered to be so when laid, shall be immediately replaced. When the railway is to be laid on or near to the surface of the ground, and in all the cuttings the permanent rails shall be laid on stone blocks, and on the embankments they shall be laid on wooden sleepers. The largest sized blocks and sleepers shall be selected for the joints.

*Seat for chair.*—Each block shall have two holes drilled in it, at right angles to the face of the block, of 2 inches in diameter and 6 inches deep, and where the chair is to be fastened on, the stone shall be dressed to a smooth bed, or seating, so that the chair may have an uniformly solid bearing.

*Oak pins.*—The contractor shall provide the oak pins, which must exactly fit, and fill the holes in the blocks, each pin shall be of solid heart of oak, free from sap, well seasoned and dry.

*Felt.*—The contractor shall provide pieces of the patent felt to be placed on the blocks for the chairs to be seated upon: each piece shall be at least 9 inches long and 5 inches wide.

*Quality and of size sleepers.*—The wooden sleepers to be used on the principal embankments shall be of solid heart of oak, free from sap, or of good sound larch. Each sleeper shall not be less than 9 feet long, 10 inches wide, and $4\frac{1}{2}$ inches thick, when cut out of the round log, such log shall not be less than 10 inches diameter at the smaller end, which, when cut up the middle, shall from two sleepers, but when put down whole may be $8\frac{1}{2}$ inches diameter at the smaller end. Any sleepers that may be damaged or split will be rejected.

*Spikes.*—For fastening the chairs to the blocks or sleepers, two wrought iron bolts or spikes will be required for each chair: each spike shall be made of the best tough iron, 7 inches long, $\frac{5}{8}$ inch in diameter; and shall have a large mushroom head to cover the fillet upon the chair.

*Chairing the blocks.*—For fixing the chairs to the blocks, the holes, having been bored, shall be scraped and cleaned out, and the surface of the stone levelled and dressed smooth, to receive the felt and chair: the oak pins shall be inserted and driven completely home, and sawed or cut smoothly off at the top, and made level with the stone. A hole shall be bored through the centre of each pin, to the bottom, with a proper sized augur; the felt and chair shall then be fitted on and fastened by driving the spikes into the holes in the pins. This is an operation to be particularly attended to, and should any spike drive so readily as, in the opinion of the engineer or the inspector, shall not sufficiently or firmly fix the chair to the block, or if the spike shall swerve from its true direction, and the head shall not be found, when driven, to clip fairly to the fillet of the chairs, the contractor shall take off such chair, and by using a thicker oak pin or a smaller augur to bore the holes, shall so cause each spike to require a smart blow to drive it home, and thus more securely fix the chair to the block: or, if necessary he shall correct the direction of the hole and replug the block, so that the spike drives plumb.

*Spiking chairs.*—In fastening the chairs to the sleepers, great care must be taken that the chairs are fixed exactly on the centre line of the sleeper, in order to secure a firm bearing and avoid any rocking or working of the sleeper by the passage of the trains, and great care must also be taken in driving the spikes and in levelling the top for receiving the chair for its whole base, and that the proper bevel be allowed for the cone on the carriage wheels.

*Keys.*—The keys for fastening the rails in the chairs shall be made of good, sound, well seasoned oak. Those for the joints shall be inches in length, and for the middles inches in depth, and both inches in width, rounded to fit the rail and chair. They shall be compressed by being forced through a mandril, and shall afterwards, until used, be carefully preserved from exposure to damp, so that when driven they may expand and remain permanently tight in the chair.

*Driving keys.*—In driving these keys, a set hammer shall be used, and they shall be driven with considerable force, and care must be taken not to chip or crush the key in driving. Any damaged keys shall be removed and replaced immediately by sound ones.

*Fixing rails.*—After the blocks and sleepers are properly chaired, and well bedded in their places, the rails, which will weigh about 75lbs. per yard, shall be placed in the chairs, and well and effectually fastened with the wooden keys, as before described. The distance between the inner edges of the rails for each road, shall, when thus fastened, be 4 feet 8½ inches. The rails at the joints opposite to each other, in a line at right angles to the road, shall be exactly of the same level (except on curves) and they shall each have a slight bevel to allow for the cone of the carriage wheels. Round sharp curves the outer rail must be slightly elevated: the exact measure of this elevation will be furnished from time to time by the engineer.

*Joints of rails.*—The joints of the rails shall be perfectly level and well fitted, and there shall be left a slight opening to allow for expansion. The length of this opening, and the lateral level of the rails, will be furnished by the engineer when required.

*Inclination to be preserved.*—The greatest care must be taken when fastening the rails in the chairs, to preserve the proper inclinations hereinafter described.

*Gauge.*—There will be two distinct lines of road, or 4 lines of rails, throughout. The spaces between the roads shall be clear 6 feet, and the 4 rails shall be parallel to each other, and shall be laid most exactly in the true line or curve as set out by the engineer on the ground, and especial regard shall be had to preserving the true distance from the rails to the parapets of bridges, so that the clear space may be equal on each side.

*Quantities of materials.*—It has been before stated that the length of the railway described herein is about , of which will be on or near the level of the ground, or in cutting, and on embankments, and from the descriptions already given, it appears there will be required about , cubic yards of ballast , stone blocks , wooden sleepers , pieces of patent felt , iron spikes , oak pins , wooden keys.

These quantities, however, are merely stated to assist the contractor, it being understood, as is hereinbefore expressed, that the directors are not answerable for the accuracy of, nor will they be bound by these quantities.

*Cottages.*—There will be cottages required, the situations of which are marked upon the plan, and they shall each be built according to the form and of the dimensions represented on the drawing No. : where a greater depth of foundation is required for the walls than shown on the drawing, it will be paid for extra according to the schedule of prices.

In the appendix of this specification, (page ,) a description of these cottages is given, but, although the whole of the articles required for them may not there be detailed, the contractor must fully understand that the cottages according to the drawings are to be finished by him in a neat and superior style. He shall provide all the materials and execute the workmanship to the entire satisfaction of the engineer, and he shall do every thing to render the cottages convenient and fit for occupation, according to the intent and meaning hereof.

*Mile posts.*—There shall be mile posts, and quarter mile posts provided and placed in the ground at proper distances by the side of the railway; the former shall be 6 feet long, 12 inches broad, and 6 inches thick; the latter shall be 5½ feet long, 8 inches wide, and 4 inches thick: both shall be 2 feet into the ground.

The whole of the works herein described must be finished on or before the day of

*Engineer has full controul over the works.*—Nothing herein contained is intended to prevent, nor shall prevent the engineer from having the most full and entire controul of the whole of the works herein described, and if at any time during the progress of the said works and before their completion, he, the said engineer shall think it desirable to commence and carry on the formation of the permanent road, the contractor shall for that purpose immediately set about its execution, and shall cart or convey blocks, sleepers, ballast, ashes, sand or gravel, rails and chairs, and every other article and thing necessary thereto, to the place where the engineer shall direct; and the engineer shall from time to time, and at all times, have full power to direct the contractor to facilitate or push the works, whether partially or wholly, and of whatever kind or nature, and the contractor shall, immediately on such directions being given, increase the number of his workmen, and use his utmost endeavours to carry the same into effect, any thing to the contrary of which herein contained notwithstanding.

*Contractor may use permanent road.*—In order to save the contractor the expense of procuring temporary rails and chairs, for the full length of the road herein specified, the Company will, so soon as the contractor shall have completed a certain distance that shall, in the opinion of the engineer, be firm enough for receiving the permanent road, deliver to the contractor at

the rails and chairs for that purpose, but no rails or chairs which shall thus or in any other manner be furnished to the contractor, shall be made use of in the formation of the temporary roads; and the permanent road shall only be laid when, in the opinion of the engineer it is safe or desirable so to do, and if in the further progress of the works, such permanent road shall be damaged, or be allowed to fall into bad repair, the contractor shall, if required, when the works are completed, take up and relay it, provide fresh ballast, and do every thing required for forming the permanent road, as if the same had not been previously laid.

*Contractor responsible for due care of rails and chairs.*—The contractor shall be considered responsible for the care and preservation of the rails, chairs, keys, or other materials, belonging to the Company (shall any other be delivered to him) from the time of their delivery to the expiration of his contract. Any rails, chairs, keys, or other materials lost or damaged during that period, shall be immediately paid for by the contractor at the cost price to the Company, or at a price to be fixed by the engineer, and the amount of which shall be deducted from the next, or any payment to the contractor by the Company under this contract.

*Company's materials to be taken by contractor at a valuation.*—The contractor shall also take at the cost price to the Company, or at a price to be fixed by the engineer, any timber, bricks, stone, or other materials (if any) which the Company may become possessed of during the progress of the works, the amount of purchase money to be deducted as above directed.

The whole of the works herein specified shall be entirely completed to the satisfaction of the engineer, on or before the

The contractor shall keep the railway and the whole of the works herein mentioned in the most efficient state of repair, during the execution thereof, and for 12 calendar months after their entire completion; during which time he shall effectually preserve the fences, quicks, and gates, keep fully open the side ditches and drains for the most effectual drainage of the roadway, preserve the most perfect uniformity of the rails, take out and replace all the broken or damaged blocks, sleepers, spikes, keys, pins, &c. procure additional supplies of ballast, ashes, or broken stone, preserve the uniformity of the slopes of the cuttings and embankments, and cultivate the vegetation thereon, and he shall do every other matter or thing, (without hindrance to the passage of the engines, waggons, or other carriages, which the directors may require or permit to pass along the road) to the satisfaction of the engineer, so that the works may at the expiration of that period be delivered up to the Company in the most perfect state of repair.

During the time of upholding, the contractor's workmen shall be under the direction of the Company's officers, and shall afford every assistance in their power in case of accident, and they shall clear the rails and stations from snow or ice when required so to do.

*Personal attendance of contractor required.*—The contractor shall not absent himself from the works without leaving a fully authorised agent to act in his absence, nor shall he, without written permission from the engineer, let or relet the works to any other person or persons.

*Not to keep tommy shops.*—The contractor will not be allowed to keep any provision or other kind of shop, nor give tickets to a shop kept by any other person, nor shall he directly or indirectly oblige his workmen to deal with any other person in particular, but he shall pay wages in the current coin of the realm, on the works, and not at any public house or beer shop.

*Written dimensions to be preferred.*—The written dimensions, in figures, on the drawings, shall be taken in preference to measurements by the scales, whenever such are attached to the drawings, and in the event of any dispute arising upon the meaning of this specification, or of any of the plans, sections, or drawings herein referred to, such dispute shall be decided by the engineer, whose decision shall be final and binding upon all parties.

*Pay every two months.*—The contractor shall, once in two months, furnish to the engineer a detailed account of the work actually done, and of the materials actually used in the construction of the said works, which account the engineer will examine, value, and, if correct, certify; and the Company will pay the amount so certified deducting 10 per cent, which is to be kept in hand till the completion of the work, as a security for the fulfilment of the contract.

The contractor shall furnish to the engineer, a detailed estimate of the quantities and prices, upon which the amount stated in the tender shall have been obtained; and the prices there set forth shall form a basis by which to obtain the amount of any extra work that may hereafter be required, or of any deduction, should any portion of the present works be abandoned.

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## ART. II.—BOILER INCRUSTATIONS.

THE incrustation of boilers by saline deposits was a much more important subject at one time than it is now, as nothing has been more clearly established, of late years, than that boilers may be preserved from any injurious incrustation by abundant blowing off. Brine pumps are now in extensive use for withdrawing a certain quantity of water at every stroke of the engine; and the water so withdrawn has to pass through or among pipes carrying the feed-water to the boiler, so that some interchange of heat is there effected. These refrigerators, however, as usually constructed, are in some respects bad things, as the small pipes of which they are built are liable to get choked up, thereby endangering the boiler by the unconscious concentration of its contents. To guard against this danger, every engine fitted with brine pumps should be provided with a hydrometer for telling the specific gravity of the water in the boiler, so that the engineer may not be cheated by the defective action of the pumps, or suppose that they are operating when they are really inert. In the case of blowing out a boiler in the usual way, the engineer looks at his glass gauge tube, and keeps the blow-off cock open until the water-level has descended through the required distance, so that, under these circumstances, no doubt can arise that the boiler has been emptied of a certain quantity of water; but there is no such assurance in the case of the continuous extraction of the water by brine pumps; and all boilers using this expedient should be fitted with hydrometer gauges as a precaution against the contents of the boiler being suffered to reach an injurious concentration. Numerous prescriptions have at various times been given as antedotes to incrustation; such as putting potatoes and other vegetable matters into the boiler, or in the case of a steam vessel taking the feed-water from the bilge. The application of oil to the flues has also been recommended; and some boilers are fitted with a contrivance to inject oil into them just before the steam is let down. We look upon all such expedients, however, as needless, and are confident that boilers require no other preservation from incrustation than effectual blowing off under favourable circumstances. Collecting vessels are in some cases advantageous, as they enable a less amount of blowing off to suffice; and, in the case of the feed supplied to the boiler being muddy water, they conduce to convenience and save fuel by obviating priming, unless, indeed, a blow-off be used such as Mr. Lamb proposes. The prevailing fault among engineers is that they do not blow off enough, the idea probably being that a considerable check is given to the generation of the steam by the introduction of colder water in lieu of the water abstracted; but the waste of heat by effectual blowing off is very inconsiderable—much less, indeed, than is occasioned by the difficulty of getting steam from brine, or of transmitting heat to the water through flues covered with incrustation, much of which heat, in consequence, ascends the chimney. There is no gain, therefore, in any respect, by penuriousness in blowing off; and there is much injury to the boiler, for incrusted plates become overheated; thay blister, crack, and get burned out, and make expensive repair indispensible. Proprietors of engines should accept of *no excuse* for the accumulation of salt or incrustation within their boilers; for such deposits arise altogether from insufficient blowing off. Of Dr. Ritterbrand's recipe for preventing incrustation by introducing sal ammoniac into the boilers, and of the ingenious action of that substance on the iron, we have spoken in previous numbers, and need not again repeat the condemnation.

The best method of scaling boilers appears to be by lighting a train of shavings in the furnaces and flues after the boilers have been emptied of water. The rapid expansion of the metal, thus occasioned, causes the scale to crack off; and, if the flues be then washed down with a hose, the scale will fall to the bottom of the boiler, and will issue out with the water on taking off the mud-hole doors. This plan of scaling, however, is one that the engineer must execute himself, and must not entrust to firemen or other subordinates, as the metal of the boiler might be damaged if the heat were made too great. The safety valve should obviously be kept open while the boiler is being heated and cooled, to obviate any pressure or exhaustion within it. This plan of scaling, however, will seldom be necessary if due attention be paid to blowing off by the engineer; and, if the quantity of scale be inconsiderable, or partial, in its attachment, the best plan will be to chip it off with a hatchet-faced hammer, and then wash down the flues with the hose, as before described.

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## ART. III.—EQUILIBRATED ARCHES.

IN a former number of the ARTIZAN,* we investigated at considerable length the conditions which ought to regulate the construction of equilibrated arches. We now give an example of the method of applying our formulæ to the particular case of an arch 230 feet span, 80 feet rise, and 12 feet thickness in the crown.

Since the base or span of the arch is 230 feet, the semi-span, or, as we formerly termed it, the greatest amplitude, is 115 feet; therefore, if we consider the ordinates to be placed along the roadway at intervals of 5 feet, there will be 23 such intervals and 24 ordinates, including the parameter or thickness at the crown, and the vertical distance between the impost and the roadway. Hence the series of amplitudes will be 5, 10, 15, 20, &c. up to 115, which is equal to the given semi-span. Now, the first step in the process of calculation is to determine the modules of the curve; and for this purpose, there are two different formulæ given in our former article, but we shall employ the one that involves the angle of condition, as being simpler than the other, while at the same time it requires less labour. Here follows the calculation by logarithms:—

Thickness at the crown of the arch, BG = 12 feet - log. 1·0791812
Thickness together with the rise, BG + BG = 12 +
80 = 92 feet - - - - - log. 1·9637878 subtract.

Angle of condition CGL = $\theta$ = 82° 30' 19" log, cos. 9·1153934
Consequently it is $(45° + \frac{1}{2}\theta) = 45° + 41° 15' 9\frac{1}{2}'' = 86° 15' 9\frac{1}{2}''$, and the logarithmic tangent of this is 11·1837778.

Constant number 0·4342945 - - log. 9·6377843
Semi-span 115 - - - - log. 2·0606978 add.

1·6984821
86° 15' 9½" log. tan. 11.1837778 - - log. 0·0732707 subtract.

Modulus = 42·19 feet - - - log. 1·6252119

Having thus discovered the modules of the curve, the next step of the process is to find the constant logarithmic differences for $n$ and $\frac{1}{n}$, as stated in the investigation, and for this purpose we have

Difference for $n = 0·4342945 \times \frac{5}{42·19} = 0·05147$; and difference for $\frac{1}{n} = 10 - 0·4342945 \times \frac{5}{42·19} = 9·94853$; the process for the ordinates will therefore be as in the following table.

| Amplitudes. | Logs. $n \times \frac{1}{2}$ par | Logs. $\frac{1}{n} \times$ par. $\frac{1}{2}$ | Vols. of $n \times \frac{1}{2}$ par. | Vols of $\frac{1}{n} \times \frac{1}{2}$ par. | Vols. of the Ordinates. |
|---|---|---|---|---|---|
| 0 | 0.77815 | 0.77815 | 6.00 | 6.00 | 12.00 |
| 5 | 0.82962 | 0.72668 | 6.76 | 5.33 | 12.09 |
| 10 | 0.88109 | 0.67521 | 7.61 | 4.73 | 12.34 |
| 15 | 0.93256 | 0.62374 | 8.56 | 4.21 | 12.77 |
| 20 | 0.98403 | 0.57227 | 9.64 | 3.74 | 13.38 |
| 25 | 1.03550 | 0.52080 | 10.85 | 3.32 | 14.17 |
| 30 | 1.08697 | 0.46993 | 12.22 | 2.95 | 15.17 |
| 35 | 1.13844 | 0.41786 | 13.75 | 2.62 | 16.37 |
| 40 | 1.18991 | 0.36639 | 15.48 | 2.33 | 17.81 |
| 45 | 1.24138 | 0.31492 | 17.43 | 2.07 | 19.50 |
| 50 | 1.29285 | 0.26345 | 19.63 | 1.83 | 21.46 |
| 55 | 1.34432 | 0.21198 | 22.10 | 1.63 | 23.73 |
| 60 | 1.39579 | 0.16051 | 24.87 | 1.45 | 26.32 |
| 65 | 1.44726 | 0.10904 | 28.01 | 1.29 | 29.30 |
| 70 | 1.49873 | 0.05757 | 31.53 | 1.14 | 32.67 |
| 75 | 1.55020 | 0.00610 | 35.50 | 1.01 | 36.51 |
| 80 | 1.60167 | 9.95463 | 39.96 | 0·90 | 40.86 |
| 85 | 1.65314 | 9.90316 | 44.99 | 0.80 | 45.79 |
| 90 | 1.70461 | 9.85169 | 50.66 | 0.71 | 51.37 |
| 95 | 1.75608 | 9.80022 | 57.02 | 0.63 | 57.65 |
| 100 | 1.80755 | 9.74875 | 64.20 | 0.56 | 64.76 |
| 105 | 1.85902 | 9.69728 | 72.28 | 0.50 | 72.78 |
| 110 | 1.91049 | 9.54581 | 81.37 | 0.44 | 81.81 |
| 115 | 1.96196 | 9.59434 | 91.61 | 0.39 | 92.00 |

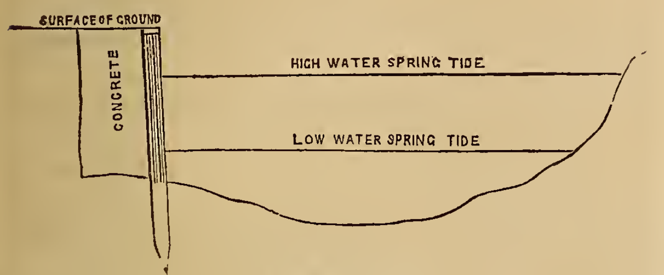
From these ordinates the figure of the arch may be constructed, after the manner shown in the original paper.

* ol. II, page 83

## Art. IV.—CAST IRON PILING.

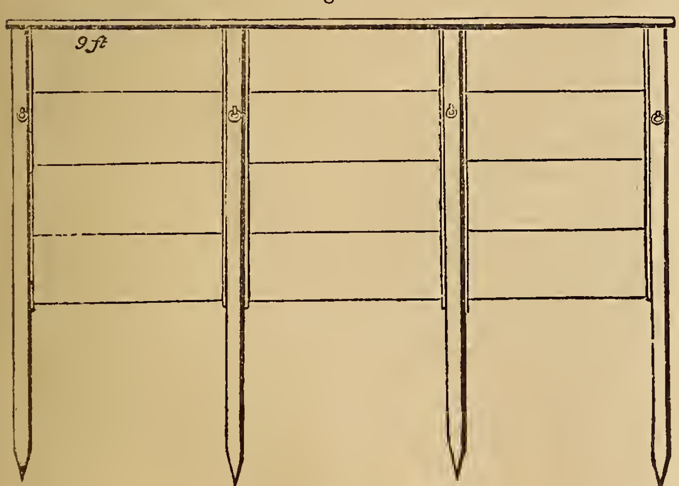
Cast iron piling has of late years been supplanting wooden piling for many purposes, and appears likely to come into extensive use. Mr. Hartley, the engineer of the Liverpool docks, who employed it largely several years ago in some of the works under his direction, speaks highly of its capabilities, and it has likewise been employed by several of the London engineers with satisfactory results. Of these applications, that which is best known is probably that which has been carried into effect in the Brunswick Pier at Blackwall, where the whole face of the pier has been formed by driving in cast iron piles into the ground at intervals of about 10 feet apart, and filling the intervening space with cast iron plates sliding in grooves cast upon the sides of the piles. The space behind the plates is filled in with concrete. Similar piling is employed in forming the river wall of the Island Lead Works at Limehouse, which is represented in the accompanying figures, of which Fig. 1, is a section shewing the bed of the river; Fig. 2, a front elevation; and Fig. 3, a plan.

Fig. 1.



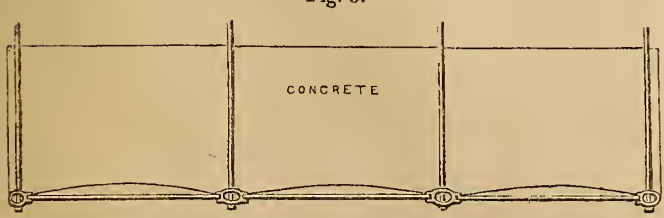

CAST IRON PILING.
Transverse Section.
Scale 1-16 inch = 1 foot.

Fig. 2.




CAST IRON PILING.
Front Elevation.
Scale 1-8 inch = 1 foot.

Fig. 3.




CAST IRON PILING.
Plan.
Scale 1-8 inch = 1 foot.

The late Mr. Ewart, of Woolwich, many years ago took out a patent for the use of cast iron piling, with which he proposed to form coffer-dams and other similar structures, but the forms of pile he employed were for the most part inconvenient and inefficient and the application did not at that time attract much notice. For sheet piling, cast iron has been used by Mr. Walker and other engineers with good effect. Mr. Hartley recommends cast iron piles to be driven with a light ram, and if the operation be carefully performed, there is not, he says, much danger of fracture.

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## Art. V.—NOVEL FORMS OF SHOT.

Sir George Cayley communicated to the *Mechanics' Magazine* the results of some experiments made by him several years ago on various forms of shot with the view of obtaining a more efficient species of projectile than the common cannon ball, by which a large amount of the mechanical effect is lost from the large sectional area exposed to the atmospheric resistance. The forms of shot experimented upon by Sir George Cayley are exhibited in the accompanying figures.

Fig. 1.


Fig. 2.

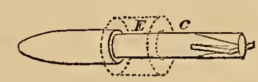


Fig. 4.

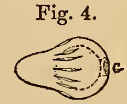

Fig. 3.


Fig. 1 is an iron shot, made heavy in front, and furnished with feathers placed spirally, similar to those of an arrow. As this form of shot leaves spaces between the ends of the feathers, a wooden wadding was used in addition to the usual wadding, in order that the whole force of the powder should be communicated to the missile. These waddings were, however, found to be inadequate, being blown through the spaces formed by the feathers; and the axis of the missile did not preserve the line of its flight, nor did it acuqire the rotatory rifle-action. This form, when elongated to resemble an arrow more closely, was shattered by the explosive impulse of the powder.

Fig. 2 is a somewhat similar projectile, upon which a cylindrical wooden wadding is placed, so as to fill the bore of the gun, and preserve the missile concentric with the bore. This wadding is shod with a ring of iron in front, and presses against a shoulder formed upon the shot. This shot did not fly fair; the tail vibrated from side to side, and the resistance thus created soon caused the shot to fall down.

Fig. 3 is a shot with oblique feathers of great length, which preserves it concentric with the barrel of the gun: this shot generally went well without vibrating, spinning round on its axis perfectly, and its range exceeded that of the round shot by a quarter of a mile. Its chief defect is that it requires a wooden wadding, wnich would endanger intermediate objects; otherwise it might be improved, as Sir George Cayley suggests, by a slight enlargement of the hinder part.

Fig. 4 is a shot which requires no extraordinary wadding: it is pear-shaped, the smaller end being foremost and solid, while the after end is hollow, and fills up the bore of the gun, so that the centre of gravity is in advance of the centre of resistance. Oblique grooves or notches are cut upon the after end of this shot, which give it a spinning motion similar to a rifle ball.

The sugar-loaf shot of the Messrs. Lancaster receives its rotatory motion in the gun, so that even if the lighter part be in the front when fired off, it will remain so: such a shot may be made much heavier than a round shot filling the same bore, and with an equal initial velocity, its momentum and diminished resistance would give it a greater range. This shot from its increased weight, would require a greater charge of powder to give the same initial velocity, and, consequently stronger guns; but the difference in expense might be overlooked for special purposes, and the shot might be made of cast iron, with a leaden belt to take into the grooves of the rifled barrel.

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## Art. VI.—STEAM TO INDIA BY WAY OF TRIESTE.

We have on various occasions expressed a favourable opinion of the Trieste route to India, and should have been content with that record of our opinion to leave the result to be determined by the practical trial the line is about to receive; but the receipt from a friend in Germany of a very recent map of the German railways has again brought the question before us, and enables us at the same time to state the existing condition of the railway lines that are to unite the English Channel and the Adriatic. Ostend and Trieste are at the present moment connected by lines either complete or in progress, but some of these lines proceed by a circuitous route, and other lines have been projected to shorten the distance. We shall first state the route taken by the line of communication between Ostend and Trieste, already completed or completing; next, the route taken by the lines projected to shorten the distance; and lastly, the route that would reduce the distance between the termini to a minimum consistently with practical considerations, and which will probably be the one ultimately adopted. The reader will be able, from this statement, to lay down the railways on a map of Germany.

From Ostend the railway proceeds to Cologne, through Bruges, Ghent, Malines, Louvain, Liege, Verviers, and Aix-la-Chappelle. This railway is completed, and a map of it is given in No. VI. of the Artizan. From Cologne a line now in progress runs down the banks of the Rhine to Dusseldorf, from whence to Elberfeld there is a railway already finished. From Elberfield there is a railway in progress to Hanover, which runs through Hagen ,Lippstadt, Ems, Bielefeld, and Minden; and from Hanover there is a railway already completed to Dresden, which runs through Brunswick, Wolfrabüttel, Magdeburg, Halle, Leipsic, and Riesa. From Dresden to Buzlau there is a railway in progress which passes through Bauzen and Gorlitz, and from Bunzlau to Oppeln there is a completed railway which passes through Liegnitz, Breslau, and Ohlau. From Ohlau to Leipnik there is a railway in progress which passes through Kosel, Ratibor, Oderberg and N. Titschin, and from Leipnik there is a completed railway to Gratz passing through Nagapedi, Lundenberg, Angern, Vienna, Baden, Solenau, and Bruck. In this line, however, there is a short break between Glacknitz and Murzaschblag, which is a very mountainous region; but it is not to be supposed that any engineering difficulties which here present themselves should be insuperable when the traffic justifies a large expenditure, or that the construction of a short railway should be impossible where a common road is already carried. From Gratz to Trieste a railway is in progress passing through Marburg, Cilli, Lanbach, Idria, Gorz, and Monfalcone. Some of the railways marked as in course of completion have, we believe, been completed since the map was drawn, and the completion of the residue cannot now be a work of much time.

Of the lines projected to shorten the distance, the first is one from Lippstadt to Eisenach near Gotha, which passes through Yaderhorn, Karlshafen, and Cassel. From Eisenach there is a railway through Gotha, Erfurt, Weimar, and Merseburg, to Leipsic. From Dresden, too, to Prague there is a projected line, which runs along the banks of the Elbe, and from Prague to Vienna there is a line running through Kollin, Pardubitz, Dahm Trübau, and Brunn.

Of the last class of lines we have mentioned, viz., those which, though neither commenced nor projected, may be expected to be made, as they would reduce the distance betwen the ultimate termini to a minimum, there are fortunately only two, and they are short and appear to be easy of construction. The first is from Coblentz to Mentz, running along the banks of the Rhine, which would be shorter than the London and Brighton railway; and the second from Regensburg to Lintz, running along the banks of the Danube, which would be about the length of the London and Birmingham. If these lines were made, the route, after leaving Cologne would be through Bonn, Coblentz, Mentz, Frankfort, Aschaffenburg, Wurzburg, Schweinfurt, Bamberg, Nuremberg, Regensburg, Lintz and Vienna. Throughout Germany there are many alternative lines, but the whole must meet at Vienna, as they cannot pass through the Alps; yet, the necessity of meeting at Vienna occasions a considerable *detour* which it would be desirable to avoid if Trieste were to remain the eastern terminus. This however, does not appear possible: the railways *must*, before many years, descend the Danube to Constantinople, and Trieste, so far as our oriental intercourse is concerned, will cease to be a place of any importance.

Between the Trieste and Marseilles routes a keen competition is on the point of being commenced. The Peninsular and Oriental Company has recently constructed some very swift steamers, to ply between Marseilles and Alexandria, while Mr. Waghorn is the most active among the partizans of the route by Trieste, and some steam vessels have lately been placed at his disposal by the Government to enable him to test it fairly. A railway between Boulogne and Paris is in course of construction, and there is another in a similar condition between Paris and Lyons. From Lyons to Avignon a railway is proposed to be made, and a railway is in course of construction between Avignon and Marseilles. The distance from Lyons to Avignon is about as great as the distance between London and Manchester, and the construction of such a railway must be the work of considerable time. The railway link between Ostend and Triest, will, therefore, there can be little doubt, be completed before that between Boulogne and Marseilles, and if completed first, this transit, though the distance is the greater, will then be accomplished in the shorter time. In the voyage between Trieste and Alexandria there is a saving in distance of several hundreds of miles, and although the total distance from London to Alexandria, *via* Marseilles may be no greater than that by way of Trieste, it must occupy a longer time as there is the least railway and the most sea travelling in it. Even were the fact otherwise, however, we do not believe that the route through France is the one in which the intercourse could continue, as the natural terminus of the route through Germany is Constantinople, and it is viewed under all the disadvantages of an incomplete scheme when the terminus is placed at Trieste. A railway is at present in course of construction along the valley of the Danube, which, starting from Vienna, runs through Pressburg and Pesth in the direction of Belgrade. Belgrade is about half way between Vienna and Constantinople. It does not appear to us that passengers for the East would proceed through France to take ship at Marseilles if they could proceed by railway direct from Ostend to Constantinople.

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## Art. VII.—INDIAN RAILWAYS.

The following is the Report upon the practicability of introducing railways into India, and upon an eligible line to connect Calcutta with Mirzapore and the north west provinces.

From Mr. F. W. Simms, Consulting Engineer to the Government of India, and Director of the Railway Department.

A. H. C. Boileau, Captain, } Bengal Engineers.
J. R. Western, Captain, }

Dated March 13, 1846.

1. We have the honour to submit our report upon the practicability of introducing a system of railways into India, and of their application to the peculiarities and circumstances of the country and climate. To answer the questions relative thereto, as proposed in the minutes of the Honourable the Court of Directors of the 7th May, 1845, and likewise to make our report from a personal examination of the country, upon the direction of a line to be recommended for a railroad from Calcutta to Mirzapore and the north-west provinces.

2. We would commence by stating our opinion that railroads are not inapplicable to the peculiarities and circumstances of India, but, on the contrary, are not only a great desideratum, but, with proper attention, can be constructed and maintained as perfectly as in any part of Europe. The great extent of its vast plains, which may, in some directions, be traversed for hundreds of miles without encountering any serious undulations, the small outlay required for Parliamentary or legislative purposes, the low value of land, cheapness of labour, and the general facilities for procuring building materials, may all be quoted as reasons why the introduction of a system of railroads is applicable to India.

3. In the minute of the Honourable Court of Directors of the 7th of May, 1845, the following occurs in the third paragraph:—"Independently of the difficulties common to railroads in all countries, there are others peculiar to the climate and circumstances of India, which may render it advisable that the first attempt should be made on a limited scale. These peculiar difficulties may be classed under the following heads, viz.:—1. Periodical rains and inundations. 2. The continued action of violent winds and the influence of a vertical sun. 3. The ravages of insects and vermin upon timber and earthwork. 4. The destructive effects of the spontaneous vegetation of underwood upon earth and brickwork. 5. The unenclosed and unprotected tracts of country through which railroads would pass. 6. The difficulty and expense of securing the services of competent and trustworthy engineers."

4. To all these difficulties we beg to reply as follows:—

I. As to the periodical rains and inundations.—We do not expect that, with a judiciously selected and well-constructed line, any serious mischief to the works may be anticipated from this cause—nothing but what a moderate annual outlay will set to rights. The practicability of keeping a railway in order is shown by the existence of bunds and roads, both metalled and unmetalled, in various parts of the country, which are kept in order at a trifling outlay. It must, however, be borne in mind, that, although this opinion is based upon what we have ourselves witnessed as the effect of a season when the floods were unusually high, both in Bengal and the Upper Provinces, yet, in after years, unprecedented inundations may occur, causing serious damage to works which shall have been constructed with a view to resisting only the highest floods hitherto known.

II. The continued action of violent winds and influence of a vertical sun.—Suitable arrangements in the construction of the works will overcome any difficulty arising from these causes as to the line itself. These effects will be more felt in the working of the trains, especially the wind, at high velocities, but no fears need be entertained upon this subject as to the ultimate result, though, during the prevalence of the hot winds, more than usual attention will be requisite in watching and guarding against the effects of friction of such parts of the engines or carriages as may be exposed to the most intense heat.

III. The ravages of insects and vermin upon timber and earthwork.—

If the information we have received be correct, that the destructive action of insects upon the teak and iron wood of Arracan amounts to nothing, or next to nothing, that question is at once disposed of; but should further investigation show that such is not the fact, recourse must be had either to the use of stone, or to the employment of one or more of the various preparations for timber now in use in England, which it is probable may also be found desirable on the score of economy to render the timber more durable. This, however, at present is by no means certain. Captain Western, who has been in Arracan, states that he would not guarantee teak as resisting damp and insects, but iron wood he knows from practical experience to resist both, and has seen a post taken up, after having been in the ground 15 years, as sound as the day it was put in. To the earthwork no serious mischief is to be apprehended from this cause, if the overseers and labourers on the line discharge their duties in a proper manner. It is true that earthworks in the Upper Provinces, constructed in a loose soil, have occasionally been damaged by the undermining of rats, crabs, otters, or other burrowing animals, but it appears that constant vigilance would provide an effectual remedy for this, as well as for the next following difficulty.

IV. The destructive effects of the spontaneous vegetation of underwood upon earth and brickwork.—To obviate this evil nothing more is required than a faithful discharge of the duties of the overseers and labourers, in rooting up every germ of such vegetation as soon as it appears. Captain Boileau suggests that the attention of the persons in charge of those portions of the line, passing through young saul forests, must be particularly directed to this point, as trees of this kind, after having been cut down to clear ways for trigonometrical operations, have been known to spring up again to an altitude of 15 feet in two years; and in various parts of the country the rapid growth of Palma Christi (the castor oil plant), the gigantic reeds called Surkunda and Nurrul, and many other such wild productions, may give considerable trouble, though the strong roots of the latter are admirably adapted for giving stability to an earthen bank. The roots of the Peepul tree are particularly injurious to brickwork, but are tolerably easily of extraction.

V. The unenclosed and unprotected tracts of country.—A fence similar to our quick fences in England will answer through the open and cultivated parts of the country, which may or may not be employed through the districts covered with jungle, as circumstances may require. Such fence may be formed of the plant called the Berandu or the Mysore thorn, or the prickly pear, all of which, and perhaps many others, if kept well trimmed, would make a suitable fence. In several localities where stone is obtainable in abundance, this material might, and, in certain cases, where the soil is too barren for the growth of hedges, must be used for boundary walls, and, in the vicinity of saul forests, the exceeding straightness of this wood renders it particularly valuable for the construction of posts and railing.

VI. The difficulty and expense of securing competent and trustworthy engineers.—This difficulty, we make no doubt, will be overcome by a suitable arrangement by the railway companies at an early period. Such, we should think, would be the sending a few native, or East Indian, young men to England to be trained, until some engines are ready to be sent to India; upon their return in charge of such engines, and under the superintendence of one or two English engineers, there would be laid the foundation for the training of as many native engine drivers as might be required. Such native youths, while in England, would not only be instructed to drive an engine, but repair them when out of order.

5. In the second paragraph of the minute of the Honourable Court of Directors, allusion is made to the probable returns of merchandise and passengers; this appears to be one of the bearings to be investigated and reported upon by us, but from an entire want of statistical information we are at present unable to give any opinion.

6. With the above view of the case we should not deem it expedient or unwise to attempt the introduction of railways into India to any extent that private enterprise might be found willing to embark capital upon; subject, however, to whatever equitable conditions and regulations the Government might think proper to require for the promotion of their own, and the general interests of the country at large, at the same time having due regard to that of the parties engaged in the enterprise.

7. As however the Honourable Court of Directors have, in the fourth paragraph of their minute, dated 7th May, 1845, noted, for the instruction of this committee, that one of its objects will be "to suggest some feasible line, of moderate length, as an experiment for railroad communication in India," we beg to suggest that there is a line in the North-West Provinces which would answer admirably as an experimental line, viz. from Allahabad to Cawnpore; but if this line be thought too extensive, as an experimental one, we believe that a line from Calcutta to Barrackpore would find no lack of British capitalists both able and willing to undertake its immediate construction.

8. Having thus expressed our opinion in general upon the subject of introducing railways into India, we will proceed to describe the route we would recommend from personal examination of the country for a line of railway, connecting Calcutta with Mirzapore, and from thence to Delhi and the north-west frontier.

9. On the line from Calcutta to the north-west provinces, first impressions would lead to the supposition that the proper direction for a line of railway, connecting Calcutta with the north-west provinces, passing through Mirzapore, would be to cross the river Hooghly at Calcutta, and proceed in the direction of Bankorra; this course would take the railway across a district of country, not only subject to periodical inundations that are among the greatest in the lower provinces of Bengal, but, in the event of the breaching of the bunds of the Dumoordur, and other rivers that it would have to cross (as was the case during the last rainy season), would be subject to the action of powerful torrents acting injuriously, if not destructively, upon the works of any railway. These considerations led to an examination of the country further to the northward, which, commencing at Calcutta, was extended along the left or east bank of the Hooghly, past Barrackpore, and crossing the river a little below Chandernagore at right angles to its stream. The line would then leave Chinsura and Hooghly on the right, and cross the trunk-road to Benares, near Mucklumpore, and from thence, nearly in a straight line, to Burdwan; at this place it would cross the Banka Nulla, and be continued nearly parallel to the trunk-road, and enter upon the land that rises above the general level of the periodical inundation.

10. The object in making this apparent *detour* is, that by flanking the Dumoodur, we should, in part, escape the water that flows towards the sea in the direction of that large river, but not be wholly free from its effects; and whenever an occurrence should hereafter take place, similar to what took place during the late inundation (viz., the breaching of the bunds of the river), a considerable amount of damage would arise to the works of the railway.

11. So long as the water is confined within the river banks no material injury would arise to the works of the railway, simply from the submersion of the country during the rains, but upon the accident before named the body and rush of water were so great as entirely to undermine and destroy a bridge near Dulla Bazaar, and to threaten destruction to the bridge over the Banka Nulla at Burdwan, by which Nullah, the surplus waters in a great degree found their vent towards the river Hooghly.

12. In addition to the foregoing considerations, it is possible that hereafter it may be considered advisable to abandon the preservation of the river bunds, and to allow the waters during the rainy season to overflow the surrounding country, in the expectation that the sedimentary matter that is now raising the bed of the river may overspread the country, and tend to raise the general level. (This has been hinted to us as a suggestion that has been made, but upon which we must be understood to give no opinion.) Such a procedure would have an effect upon the railway works that is difficult to foresee or provide for, except, in all probability, by the construction of a larger quantity of viaduct for the free passage of the waters than would otherwise be necessary, and thus increase the cost and maintenance of the works.

13. The above considerations and information obtained from Lieutenant Colonel Forbes, Captain Anderson, &c., led to an examination of the country still further to the northward, from which it appears that a very advantageous line of country for a railway exists on the left bank of the Hooghly, and crosses that river at a short distance below where it is first formed (or takes that name) by the junction of the Bhagiruttee and Jelinghee at Nuddea, from which, crossing, it would proceed due west, and pass about 10 miles to the north of Burdwan, near to a place called Balkeshun.

14. This line would quit Calcutta at its northern extremity, skirt the gun foundry at Cossipore, and take a direct line northwards, nearly parallel to the Barrackpore road, which it would cross at the bend, near Barrackpore. Hereabouts a station for the accommodation of that district might be advantageously established, from thence it might follow the general direction of the river to accommodate Chinsura and Hooghly, &c., and onward by a straight course to Goonpulla on the road between Barrasut and Ranaghat.

15. As regards simply the construction of a railway, it might with equal advantage to the works be constructed in a straight line from Calcutta to Goonpulla, and thus, by avoiding Barrackpore, &c. would be a little shorter in distance than by that route, but it appears preferable to adopt the former line, for the accommodation of that and the neighbouring localities of Serampore, Chandernagore, Chinsura, Hooghly, &c., which would then more than ever become the favourite resort of the citizens of Calcutta, and be a source of remuneration to the railway itself.

16. From Gonpulla the line would take nearly a straight line towards Ranaghat, near which it would cross the Metabhanga river, and from thence proceed almost parallel to the road leading to Kishnagur, but gradually tending to the north-west, and cross the road from Kishnagur to Santipore, near to a place called Dignagur, it would then continue to curve until it crossed the Hooghly, near to an indigo factory, called Punchilla, which is south of the junction of the Idhingee and Bhageruttee, as before described.

17. After crossing the river, the railway would be carried in nearly a straight line past Singalee, Baljoree, and Balkishun, which is the place before alluded to as 10 miles north of Burdwan.

18. The railway, if constructed by Ranaghat and Nuddea, would be

about 30 miles longer than by taking it in the direction of Hooghly and the trunk road to Burdwan, which extra distance, although it would tell largely upon a short line of railway, becomes of less importance when it forms part of a railway of so great an extent as the one under discussion (namely, to the north-west provinces, about 900 miles in length), besides which, it will pass through and accommodate a rich district of country, in addition to affording the same amount of accommodation to the Burdwan district, and, in all probability, would hereafter form a trunk from which branch railways will be made to those parts of India north and north-east of Calcutta.

19. In furtherance of this object, we extended our examination, in November last, to the country north of Kishnagur, through Berhampore and Moorshedabad to Bhagwangola, with a branch railway from Kishnagur to those places; and, although the country is highly favourable for such a project, yet the great mart at Bhagwangola is of so unfixed a character, from the extensive and continued changing of the bed of the Ganges, that unless its continuation northward and eastward be considered desirable, it would appear that a branch to Bhagwangola simply to accommodate the trade that now passes along the Ganges to Calcutta by the Sunderbunds route, will not be found to answer as a commercial speculation: a permanent point, however, on the banks of the Ganges exists at or near Rajmahal, which might be suitable to receive the great traffic of the river, and be connected with the trunk line, a little northward of Burdwan, and be found advantageous to the general trade of the country, in like manner as the proposed canal of Lieutenant Colonel Forbes would have done if that important work had been carried into execution. Such a branch railway would in no point be removed very far to the westward of the projected line of the canal in question.

20. Also as regards the comparative cost of the works on the above lines, we consider it would be less, mile for mile, on the Ranaghat line than on either of the others, that is independent of the great bridge that must cross the Hooghly in either case, the cost of which would be less the higher up the stream it is constructed.

21. The chief objection that appears to the above line is the fact that it involves the crossing of the Matabhanga river, near Ranaghat, in addition to that of the river Hooghly, which river must be crossed at any rate, in order to bring the railway into Calcutta, unless it be resolved to terminate it at Howra, on the opposite side of the river to Calcutta, which would at least be very inconvenient for business, even supposing the country between that and Burdwan was as suitable for the construction of a railway, and offered as much general accommodation to the country as the line further to the northward. Besides, the expense of constructing a bridge over the Hooghly at Calcutta would be greater than a similar crossing 60 miles higher up the stream.

22. With a view to the saving, if possible, of the extra bridge over the Matabhanga, which is a considerable river, we examined another line, that would leave the last described line nearly opposite to Chinsura, and take a more direct course to the river Hooghly, which it would cross near the villages of Collipore, on the east side thereof, and Doomurda on the west, thence onward to Inchura, where it would cross a Nullah, and leaving Sacheroy, and crossing the Bauha and Kurree Nullahs, join the Nuddea line near to the before-named Balkishun, about 10 miles northward of Burdwan.

23. The latter route would be about 15 miles shorter than by the Nuddea line, but, *pro rata*, it would be more costly in its construction, and miss accommodating a very valuable district of country which, in all probability, would pay for the extra length of railway. The crossing of the Matabhanga at Ranaghat, therefore, appears to be the chief consideration against the adoption of the more northern line, as compared with the line by Culna.

24. Upon an inspection of the most eligible place for crossing the Hooghly, on the Culna line, near the village of Doomurda, it also appeared that, in addition to the simple crossing of the stream, there was on the left or east bank a considerable extent of flat country between the wooded elevated land and the water, which is doubtless submerged during the rainy season, and seems to be the ground through which the river has wandered in former times, and left dry from the continued change in its bed. If this be correct, it will be necessary to construct a viaduct of great extent, to carry the railway over this recent alluvial deposit, in addition to the actual bridge over the river; and the uncertain expense in founding and erecting such a work in that situation is so well known that the fact need only be named to insure a dissent from its adoption.

25. Such was our opinion formed upon the spot, but before a final decision be given upon the subject it might be advisable for the railway company who may undertake the work to make a detailed survey and section of each line, and submit them for estimate and comparisons, as in a work of such magnitude the utmost saving of expense is desirable. But so impressed are we in respect to the public advantages to be derived from the more circuitous route, that we consider a comparatively small saving should not be allowed to weigh in favour of the Culna line.

26. From Balkishun, a common point on the two northerly lines, the railway would proceed nearly direct to, and cross the trunk road at about Kagsa, where the southern or Chinsura line, after passing through Burdwan, and nearly following the same course as the high road from that city, would be united with them; from thence it would take the left bank of the river Dumoodur, pass through the Raneegung collieries, and onward to where the river Barrakur joins the Dumoodur.

27. The line will next take up the valley of the Barrakur, and follow approximately the course of that river nearly for its whole extent, to the summit of the country at or near the Dhunwa pass, where a very rapid descent occurs from the westernmost range of hills in Bengal to the plains of Behar. Up to near this place the gradients of the line will be very easy, and although steeper gradients will have to be here introduced to overcome this natural barrier, we do not expect, from the levels we have taken, they need be greater than can be worked by assistant power when the trains are heavy; and it is the only place, upon the whole line, where favourable gradients cannot be obtained at a small cost, as regards the earthworks.

28. After entering upon the plains of Behar, the line will proceed nearly direct by Shuhurghollee and Nowrungabad, to the Soane River.

29. The river Soane is a formidable obstacle to the cheap construction of a railway, being two miles and three furlongs in breadth, and the foundation or natural substratum below (at present) an unknown depth of sand. The erection of a viaduct across this great river is, however, a matter of expense only, there appearing no difficulty in the case that perseverance and ingenuity will not overcome. The most suitable point for crossing the river seems to be about three miles higher up than where the trunk road now crosses it, at the foot of the range of sand-stone hills, from which much valuable material for the structure might be obtained, and for this purpose also, granite of excellent quality may be quarried about two miles south west of Nowrungabad, and about 12 miles south-east from the proposed site of the bridge. Lime also is obtainable at or near the spot.

30. In the construction of this bridge, and of all others of great magnitude, as the crossing of the Hooghly and the Jumna, hereafter to be referred to, we would recommend that they be made of ample width, not only for the railway, but also for a common highway, which may be separated from the railway by a screen of masonry. The additional cost of such extra width, at the time of construction, will be but little in comparison with the cost of a separate structure for the public highway, and compensation might be given to the railway company for the extra outlay, either by Government supplying an equivalent portion of the cost, or granting them the right of levying a toll for a given number of years.

31. On the other hand, we would advise that all bridges of great magnitude erected by Government for the purpose of any public highway in any part of India, should be constructed of ample width to accommodate a railway also, if there should appear any moderate probability that such a work would become desirable for, or likely to be executed in that direction within any reasonable period of time.

32. From the river Soane the railway will skirt the foot of the hills of the town of Saseram, two miles north-west of the proposed bridge, and then in like manner for about 74 miles west by north to the town and fortress of Chunar, on the right bank of the river Ganges, leaving the trunk road and the city of Benares considerably to the right. This is done in order to obtain better ground for the construction of the line, and a branch to Raj Ghat, opposite to Benares, 17 miles in length (leaving the main line 9 miles before reaching Chunar) would answer all the purposes of that great city, and the district of country to the northward thereof.

33. The railway will pass between the Sand-stone hills on the south side of Chunar, which will all along furnish valuable building materials for the very numerous masonry works along the line.

34. From Chunar to Mirzapore, a distance of 18 miles in the same direction west by north, the line will still keep along the foot of the hills, although a little circuitous, as it will be desirable to avoid the bad ground in the more direct course.

35. Having now explained our view as to a suitable line for a railway between Calcutta and Mirzapore, we will, before proceeding further, describe the branches we should propose to diverge therefrom to give the most extensive accommodation to the country at large, and to relieve the traffic of the Ganges proceeding to Calcutta from its great drawback during at least eight months of the year—namely, the circuitous route by the Sunderbunds, when the waters of the Bhageruttee are too low to admit of the more direct route from the Ganges to the capital of India.

36. The first branch should be from a point near Burdwan to Rajmehal, along the district of country selected many years ago by Lieutenant-Col. Forbes for the Rajmehal canal; such a railway will, in future, supersede the necessity for the canal, which, however, would have conferred great benefit on the trade of the country if carried into execution when he first proposed it; the fact that such a canal has been for many years a *desideratum*, proves the same thing in favour of the more modern mode of communication.

37. Besides the accommodation of the trade of the Ganges, it will give accommodation to Purneah, Malda, Dinagepore, Rungpore, and the country in that direction through which it may possibly hereafter be found desirable to extend this refined mode of transit.

38. After all that has been stated from time to time in favour of Lieutenant-Colonel Forbes's important work, nothing more need be added in

favour of a branch railway in that direction. This branch would be about 120 miles in length.

39. The second branch we would propose would leave the main line about 5 miles eastward of Shuhurghotee, and pass northwards through Gaya to Patna and Dinapore, thus accommodating a very important district of country, as well as the military and civil stations above-named; and on the opposite side of the Ganges, the valuable districts of Tirhoot, Sahun, &c. This branch will be about 80 miles in length.

40. Another branch might probably be adventageously made from the main line up the valley of the Soane to the coal-fields westward of Rotasgurh; but we do not lay much stress upon its immediate formation as a branch, until it be ascertained whether or not the main line from Bombay will take that course, as it appeared some time ago probable that such might be the case. Such a branch may be found desirable, if not indispensable, to the interests of the railway company, as they might thereby obtain coal for their own purposes, as well as to supply the public in that and the still higher parts of India.

41. The last branch we should propose for immediate construction on this portion of the great trunk line from Calcutta to the north-west provinces should be, as stated in paragraph 32, from about 9 miles before reaching Chunar to Raj Ghat, opposite Benares, a distance of about 17 miles.

42. We have described our view of the most suitable direction for a line of railway from Calcutta towards the north-west provinces: but it may be argued that the line passes through a comparatively barren portion of the country as compared with the valley of the great river Ganges, which has been suggested by other parties as the most eligible route for a line of railway, and which is stated to have in its favour a greater probability of becoming more lucrative than the liue we have recommended.

43. First impressions might be favourable to this view of the question. Such a result might be expected if either line was dependent wholly for its support upon the agricultural produce and population of the district through which it passes, but upon further consideration it appears to us that the ultimate result will be favourable to the direct line, for, by means of its branches to Patna and Rajmehal, it will take all, or nearly all, the trade likely to be transposed from the river to the railway in either case, and give nearly as good accommodation to the country around, and to the district northward of the Ganges as Tirhoot, Purneah, Dinagepore, &c., through which it will probably hereafter be found advantageous to extend the railway system by starting from the opposite respective termini at Patna and Rajmehal; and in addition to accommodating the trade of the river and surrounding district, it will bring forward a country now much neglected in consequence of its imperfect communication, a district which contains mineral wealth, and possesses great capabilities, as is evident from the proofs of recent improvement, to a great extent contiguous to the line of the trunk-road, within the last few years, a greater portion of which, until then, was abandoned to the beasts of the forest. This great benefit will, therefore, be in addition to nearly the same amount of accommodation being given to the whole country as could be given by the river line alone; and, lastly, a direct line between the extreme termini, where attainable, is always most desirable, especially in a political point of view, and in a country circumstanced as India is. Thus much for the traffic considerations of the subject: and it only remains to be stated, that we cannot give a decided opinion upon the engineering question without a personal examination of the river line.

44. On the extension of the line from Mirzapore to Delhi.—But little need be said respecting this portion of the proposed works. In length it will be about the same as that of the line we have already described, Mirzapore being about midway between Calcutta and Delhi. The direction of the line will be nearly as follows:—between Mirzapore and Allahabad it will trend a little to the south of a direct line, to secure better ground for a foundation to the works. Upon this portion of the line the railway will cross the river Tounse, and in order to extend it into the doab, the river Jumna must also be crossed at or near to Allahabad; a suitable spot for crossing exists near the present bridge of boats. Thus, the military magazine at Allahabad would be connected by railway with Calcutta, and, by the extension to Agra and Delhi, with the magazines at those places respectively.

45. Leaving Allahabad, the railway would keep on the south-west side of the trunk-road to Futtehpore and Cawnpore, thence it might take a direct line to Mynpoorree, which would be its proper course if continued direct to Delhi; but if it be finally resolved that the line should pass through Agra, and thence to Delhi, along the right bank of the river Jumna, it would be more desirable that the railway should procced from Cawnpore by Shekoabad to Agra, as that line would not only be shorter, but would avoid the crossing of one or more nullahs than it would have to do if taken by Mynpooree.

46. Supposing that its route would be through Agra, it would again cross the river Jumna at the latter city, a suitable site for which purpose would be a little northward of the present bridge of boats, and passing the civil lines to the north of the Government offices at Ackbar's tomb at Secundra, take a tolerably direct course through Muthra to Delhi.

47. A suitable place for a station at Agra exists, where the rails, continued from the bridge, would become level with the present surface, of the ground, about midway between the river and the civil lines, and if necessary, such station could be connected with the banks of the river at a much lower level than the railway, by a branch descending to the water's edge.

48. Before, however, determining that the main line should pass through Agra to Delhi, it is a subject for consideration whether or not it would be more desirable to take he line direct through Allyghur, and cross the river Jumna at Delhi; for this purpose a suitable place for crossing the river is immediately to the northward of the palace, whence it could be continued along the bank of the river to a station on the vacant ground at the back of the magazine, and, if necessary, can at any time be prolonged northward, past cantonments, towards Kurnal.

49. The advantages of the direct line to Delhi over that by Agra would be,—1st, the shortening of the distance between Calcutta and the frontier; 2nd, passing through, probably, a richer agricultural district than would be done on the route between Delhi and Agra; and 3rd, in case of invasion from the westward, a possible, although not probable, occurrence, the railway would be protected by the river Jumna. On the other hand, the city of Agra, at present the capital of the north-west provinces, with its magazine, would be less directly connected with the frontier and the magazine at Delhi, if situated at the extremity of a branch, than if placed upon the main line. The country also to the west of the river Jumna, although perhaps not so productive to the agriculturist as that in the doab, yet is admitted to possess a very considerable trade.

50. As respects the two routes, in an engineering point of view, there appears to be no great difference, for although on the direct line there would be the additional cost of crossing the river Hinden (no trifling matter, certainly, unless, as suggested by his Honour the Lieutenant-Governor of the Upper Provinces, the crossing be effected below the junction of the Hinden with the Jumna, if the Jumna itself be as manageable there as at Agra or Delhi). The route, by way of Agra, would be about 20 miles longer, and consequently, from that cause, increase the cost of construction to probably within a trifle of that of the direct route.

51. If Agra be accommodated with a branch line only, and that branch be terminated on the opposite side of the river to the city, would be highly inconvenient and undesirable; but if a bridge is to be constructed at Agra, at all events, to carry the railway into the city, which it would by all means do, then the consideration would be greatly in favour of taking the main line by the Agra route, for the more perfect accommodation of that great capital of Upper India.

52. Whichever of the two directions for the main line between Cawnpore and Delhi be finally fixed upon by Government as most desirable, the line can, at any future time, be extended to Kurnal and to the frontier, whore a terminus might be established on the highest and navigable part of the Sutlej, and thus connect the great rivers the Indus and the Ganges.

53. The branches to be recommended for construction on this upper portion of the main line from Calcutta to the north-west would be one to Furruckabad, a second to Allyghur, a third to Meerut, and, upon the future extension of the line to Kurnal, a branch could be advantageously constructed thence north-eastward towards the hills on which the sanitary stations of Simla and Mussooree are situated, or wherever else it may be found desirable.

54. The first branch, or that to Furruckabad, would leave the main line about 60 miles north-westward of Cawnpore; and proceed direct, the length being about 45 miles from the line, through Shekoabad to Agra, and 32 miles if taken from the direct line to Delhi through Mynpooree.

55. The second branch, or that to Allyghur, would lead direct from Agra, and would be about 48 miles long. But if the direct line to Delhi be adopted, this branch would not be required, as the line itself would pass through Allyghur.

56. The third branch would be from Delhi to Meerut, about 36 miles long, and which, if the main line takes the right bank of the river, we propose should terminate opposite to the city of Delhi, as it appears to us the traffic would not be sufficient to warrant the expense of constructing a costly bridge over the river Jumna for that purpose.

57. The fourth branch, namely, from Kurnal towards the hills, requires no further remark at the present time than we have already bestowed upon it.

58. If, however, it should ultimately be resolved that the direct line to Delhi through Allyghur be adopted, the branch to Agra would leave such main line near to Sikundra, a distance of about 40 miles.

59, We have given, as we consider, the leading facts on both sides of the question necessary for the final choice of the direction for the main line; these appear to us so nicely balanced that we should refrain from making a positive recommendation upon the subject, but if called upon to state which of the two we would prefer, we should be disposed to recommend the route by Agra.

60. The general character of the works, &c.—The heavy works upon the whole line from Calcutta to Delhi will, for the most part, be of masonry, consisting of bridges, to cross the very numerous rivers and nullahs in its course, many of which are of great magnitude, and all very consider-

able. The earthworks will be light, except at the summit of the country described in paragraph 27, at which place it may be found necessary to undertake works of a heavier kind; but, upon the whole, it is not to be expected that there exist in the world many lines of equal length requiring so small an amount of earthwork to be performed.

61. The great bridges comprise those over the rivers Hooghly and Soane, upon the lower portion of the line, and the crossing of the Jumna at Allahabad and Agra or Delhi, upon the upper portion, and although these structures will be very costly, yet there is nothing in their character that can cause them to be considered as insurmountable difficulties; the chief difficulty will be in their cost.

62. With a view to enable contracting parties to open the whole line at the earliest period with the least possible outlay, it might be advisable to permit of the laying down, in the first instance, of a single line of railway, with all necessary passing places, but this should distinctly apply to the permanent way only, as the earthworks and masonry (but more especially to the masonry works) should be constructed for the reception of a double line; this latter observation regarding the masonry should apply also to the branches, so that at any future time a second line could thereon also be applied without difficulty. The earthworks upon the branches might with safety refer to a single line only, as they will, in the branches already named, amount altogether to a trifle.

63. It is highly probable that a double line of rails will be absolutely necessary upon the main trunk line at no distant period, if not required in the first instance, and therefore we would recommend that in consenting to a single line to begin with, it should be understood to imply that such single line is only admissible until the whole length is opened to the public, when a second line should be added forthwith, if the railway company be called upon by the Government to do so.

64. We cannot but view the whole distance from Calcutta to Delhi as one line, for we are of opinion that, as such, it would be better worked and conducted under the management of one company, than if it were divided and in the hands of more numerous bodies; besides which we consider that it would also be advantageous, as well as fair, that the whole should be granted to one company, if a sufficiently sound party will come forward to undertake it, because they would then have a great length of line for a reasonable average outlay; the lower half, from Calcutta to Mirzapore, costing considerably above that average, and the upper half, from Mirzapore to Delhi, as much below it.

65. We conclude by adding that in addition to the line from Bombay joining the main trunk line, between Allahabad and Calcutta, as before alluded to, it has been suggested to us by His Honour the Lieutenant-Governor of the north-west provinces that a suitable line of country may hereafter be found for the construction of a railway from Agra to Bombay; by these two lines the north-western provinces would be effectually supplied with communication, not only with the seat of the supreme Government at Calcutta, but with the great seaports on the two opposite coasts of the continent of India.

F. W. Simms, C. E.
A. H. C. Boileau, Captain of Engineers.
J. R. Western, Captain of Engineers.

Camp Sersoul, March 13, 1846.

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## Art. VIII.—HARDWICKE HALL.

From the reign of Henry the Fourth to that of Henry the Eighth, spacious manorial houses were erected, which, presenting a castle-like appearance, were internally arranged for domestic purposes—Haddon Hall is a curious example; and this style was progressively improved, to the period above mentioned. The ruined walls and the foundations still to be traced, afford ample proof that this building was one of the largest dimensions.

In the Magna Britannia, the following account of this building is to be found; "At a small distance from Harwicke Hall are considerable remains of a more ancient Hall, which appears to have been a very magnificent edifice; and from the style of its architecture could not have been built any great length of time before the erection of the present mansion. It is now (1817) in a ruinous state, but one of the rooms remains entire, which is 55 feet 6 inches by 30 feet 6 inches, and 24 feet 6 inches high: it is floored with terras; the sides are fitted up to a certain height with oak wainscoting, and enriched with Ionic pilasters; over which are ornaments in plaster, consisting of two rows of arches. Over the large stone chimney-piece are colossal figures, one on each side, in Roman armour, reaching to the cornice, from which this room has obtained the name of the Giant's Chamber." As the capital of a domain so widely extended, it must have had a very princely appearance.

Of the founder of this building we have no certain evidence, but vestiges remain among the ruins which are of the era of Henry the Eighth, and were probably an addition. When inherited by Elizabeth, the memorable heir of this family, it was in a perfect state; but after her marriage with Sir William Cavendish, when the first Chatsworth was built, it was partially dilapidated by the very large removal of materials for the construction of that house. This was effectually completed by her when Countess of Shrewsbury, between 1590 and 1597, after the Earl's decease; during which interval the new Hardwicke Hall rose at her command. From the circumstance of there being two buildings almost contiguous to each other, of the same name, many unfounded traditions have originated, both in point of fact and locality. These will be examined with candour in the following historical sketch.

The lively and picturesque description given by Gray and the late Mrs. Radcliffe, as far as relates to the history of Hardwicke, are grounded entirely on a popular error. They are compounded from facts which belong to Sheffield, Tutbury, and Winfield; and are not peculiar to either of these mansions. Gray's poetical feeling, and Mrs. Radcliffe's richly imaginative powers, when visiting these interesting scenes, require a quotation; fictions, perhaps, in this instance, being almost as valuable as truth. Gray, in a letter to his friend Dr. Wharton (1762) observes, "I have only time to tell you, that, of all the places which I saw on my return from you, Hardwicke pleased me the most. One would think that Mary Queen of Scots was but just walked down into the park, with her guard, for half an hour; her gallery, her room of audience, her antechamber, with the very canopies, chair of state, foot stool, *lit de repos*, oratory, carpets and hangings, just as she left them; a little tattered indeed, but the more venerable, and all preserved with religious care, and papered up in winter." Somewhat more than a mere inventory might have been expected from Gray, who was particularly conversant with every style of English architecture. Mrs. Radcliffe indulges her talent of romantic description, with success, but with the same misapprehension. "Northward, beyond London, we may make one stop, after a country, not otherwise necessary to be noticed, to mention Hardwicke, in Derbyshire, a seat of the Duke of Devonshire, once the residence of the Earl of Shrewsbury, to whom Elizabeth deputed the custody of the unfortunate Mary. It stands on an easy height, a few miles to the left of the road from Mansfield to Chesterfield, and is approached through shady lanes, which conceal the view of it, till you are on the confines of the park. Three towers of hoary grey then rise with great majesty among old woods, and their summits appear to be covered with the lightly shivered fragments of battlements, which, however, are soon discovered to be perfectly carved open work, in which the letters E. S. frequently occur, under a coronet, the initials, and the memorials of the vanity, of Elizabeth, Countess of Shrewsbury, who built the present edifice. Its tall features, of a most picturesque tint, were finely disclosed between the luxuriant woods, and over the lawns of the park, which every now and then let in a glimpse of the Derbyshire hills. The scenery reminded us of the exquisite descriptions of Harewood, "the deep embowering shades that veil Elfrida," and those of Hardwicke once veiled a form as lovely as the ideal graces of the poet, and conspired to a fate more tragical than that which Harewood witnessed.

"In front of the great gates of the castle court, the ground, adorned by old oaks, suddenly sinks to a darkly shadowed glade; and the view opens over the vale of Scarsdale, bounded by the wild mountains of the Peak. Immediately to the left of the present residence, some ruined features of the ancient one, enwreathed with the rich drapery of ivy, give an interst to the scene, which the later, but more historical structure heightens and prolongs. We followed, not without emotion, the walk which Mary had so often trodden, to the folding doors of the great hall, whose lofty grandeur, aided by silence, and seen under the influence of a lowering sky, suited the temper of the whole scene. The tall windows, which half subdue the light they admit, just allowed us to distinguish the large figures in the tapestry, above the oak wainscoting, and showed a colonnade of oak supporting a gallery along the bottom of the hall, with a pair of gigantic elks' horns flourishing between the windows opposite to the entrance. The scene of Mary's arrival, and her feelings upon entering this solemn shade, came involuntarily to the mind; the noise of horses' feet and many voices from the court, her proud, yet gentle and melancholly look, as, led by my Lord Keeper (Shrewsbury), she passed slowly up the hall; his somewhat obsequious, yet jealous and vigilant air, while awed by her dignity and beauty, he remembers the terrors of his own queen; the silence and anxiety of her maids; and the bustle of the surrounding attendants. From the hall, a staircase ascends to the gallery of a small chapel, in which the chairs and cushions used by Mary still remain, and proceeds to the first story, where only one apartment bears memorials of her imprisonment, the bed, tapestry, and chairs having been worked by herself. This tapestry is richly embossed with emblematic figures, each with its title worked above it, and, having been scrupulously preserved, is still entire and fresh. Over the chimney of an adjoining dining-room, to which, as well as to other apartments on this floor, some modern furniture has been added, is this motto, carved in oak, 'There is only this: To fear God and keep his commandment.'

"So much less valuable was timber than workmanship when this mansion was constructed, that where the stair-cases are not of stone, they are formed of solid oaken steps instead of planks; such is that from the second, or state story, to the roof, whence, on clear days, York and Lincoln Catherdrals are said to be included in the extensive prospect. This second floor is that which gives its chief interest to the edifice. Nearly all the apartments of it were allotted to Mary, some of them for state purposes; and the furniture is known by other proofs, than its appearance, to remain as she left it. The chief room, or that of audience, is of uncommon loftiness, and strikes by its grandeur before the veneration and tenderness arise which its antiquities, and the plainly told tale of the sufferings they witnessed, excite. The walls, which are covered to a considerable height with tapestry, are painted above, with historical groups. The chairs are of black velvet, nearly concealed hy a raised needlework of gold, silver, and colours, that mingle with surprising richness, and remain in fresh prescrvation. The upper end of the room is distinguished by a lofty canopy of the same materials, and by steps which support two chairs; so that the Earl and Countess of Shrewsbury probably enjoyed their own stateliness here, as well as assisted in the ceremonies practised before Mary. A carpeted table in front of the canopy was, perhaps, the desk of the commissioners, or secretaries, who here recorded some of the proceedings concerning her; below which the room hreaks into a spacious recess, where a few articles of furniture are deposited, not originally placed in it; a bed of state, used by Mary, the curtains of gold tissue, but in so tattered a condition that its original texture can scarcely be perceived. This, and the chairs which accompany it, are supposed to have becn much earlier than Mary's time. A short passage leads from the state apartment to her own chamber, a small room, overlooked from the passage by a window, which enabled her attendants to know that she was contriving no means of escape through the others into the court. The bed and chairs of this room are of black velvet, embroidered by herself; the toilet of gold tissue, all more decayed than worn, and probably used only towards the conclusion of her imprisonment here, when she was removed from some better apartment, in which the ancient bed, now in the state room, had been placed. The date 1599 is once or twice inscribed in this chamber; for no reason that could relate to Mary, who was removed hence in 1584, and fell by the often-blooded hands of Elizabeth, in 1587. These are the apartments distinguished by having heen the residence of so unhappy a personage.

"On the other side of the mansion, a grand gallery occupies the length of the whole front, which is 165 feet, and contains many portraits; amongst them a head of Sir Thomas More, apparently very fine; heads of Henrys the Fourth, Seventh and Eighth; a portrait of Lady Jane Grey, meek and fair, before a harpsichord, on which a psalm-book is opened; at the hottom of the gallery, Elizabeth, stiffly proud and meanly violent; and, at the top Mary, in hlack, taken a short time before her death, her countenance much faded, deeply marked by indignation and grief, and reduced, as if to the spectre of herself, frowning with suspicion upon all who approached her; the black eyes looking out from their corners, thin lips, somewhat aquiline nose, and beautiful chin.

"What remains of the more ancient building is a ruin, which, standing nearly on the brink of the glade, is a fine object from this. A few apartments, though approached with difficulty through the fragments of others, are still almost entire, and the dimensions of that called the Giant's Chamber, are remarkable for the beauty of their proportion."

Horace Walpole (afterwards Earl of Oxford), in explaining the principles and practice of the style of architecture prevalent in the last years of Elizaheth, and the first of James the First, has selected Hardwicke Hall as an example. He, too, has been deceived, hy the difficulty of distinguishing the event which took place in the ancient castellated building, whish decidedly belong to the second Hardwicke, a mansion commanding the admiration of the century in which it arose. Mr. Walpole was particularly curious in examining dates, and that he had not ascertained, "that it was built and furnished for the reception of the Scottish queen," is at least remarkable. Let it be recollected, that she had heen heheaded four years hefore Lord Shrewsbury's death. During his life-time, he very frequently resided at Chatsworth, which his lady had built, and for which purpose the old Hardwicke had been dilapidated in part: and the Countess did not commence the new structure before 1590, when Chatsworth was neglected.

"The nobility kept up the magnificence they found estahlished by Queen Elizabeth, in which predominated a want of taste, rather than a bad one. In more ancient times, the mansions of the great lords were, as I have mentioned before, built for defence and strength, rather than for convenience. The walls thick; the windows pierced wherever it was most necessary for them to look abroad, instead of being contrived for symmetry, or to illuminate the chamhers. To that style succeeded the richness and delicacy of the Gothic. As this decliued, before Grecian taste was established, space and vastness seemed to have made their whole ideas of grandeur. The palaces erected iu the reign of Elizabeth by the memorable Countess of Shrewsbury, Elizabeth of Hardwicke, are exactly in this style. The apartments are lofty and enormous, and they knew not how to furnish them. Pictures, had they had good ones, would be lost in chambers of such height. Tapestry, their chief moveable, was not commonly perfect enough to be real magnificence. Fretted ceilings, graceful mouldings, and painted glass, the ornaments of the preceding age, were fallen into disuse. Immense lights, composed of bad glass, in diamond panes, cast an air of poverty on their most costly apartments. That at Hardwicke, still preserved as it was furnished for the reception and imprisonment of the Queen of Scots, is a curious picture of that age and style. Nothing can exceed the expense in the bed of state, in the hangings of the same chamber, and of the coverings for the tables. The first is cloth of gold, cloth of silver, velvets of different colours, lace fringes and embroidery. The hangings consist of figures, large as life, representing the virtues and vices, embroidered on grounds of black and white velvet. The cloths to cast over the tables are embroidered and embossed with gold on velvets and damasks. The only moveables of any taste, are the cabinets and tables, themselves carved in oak. The chimneys are wide enough for a hall or kitchen, and over the arras are friezes of many feet deep."

The dilapidated shell of the ancient hall at Hardwicke, which remains by the side of the more ancient structure built by the heiress of Hardwicke then countess of Shrewshury) in her last widowhood, has been already alluded to. The present hall, which has acquired an imaginary interest, on the supposition that it was one of the prisons of Mary Queen of Scots, was built after the dcath of that unfortunate princess. The second floor of this mansion is said to have been allotted for the residence of the royal prisoner, and the rooms are shewn as retaining their furniture in the same state as when she inhabited them. Over the door of a bed-room, said to have heen appropriated to her, are the arms of the Queen of Scots, with her cipher. There is a portrait of Queen Mary in one of the apartments, said to have heen painted in the 10th year of her captivity at Sheffield.

A bed, a set of chairs, and a suit of hangings are shewn, as having been the work of the royal captive: it is very probable that they were; we have proof that she was very fond of needlework, and that she employed many hours of the day during her captivity in that occupation. The furniture was probably used hy her, and brought from Chatsworth hefore the old hall at that place was taken down. We have only presumptive evidence that the unfortunate Mary ever was at Hardwicke; it is certain that if she was, it was only during a short and occasional visit of the Earl of Shrewsbury to that place. The Countess, heing at Hardwicke in 1577, several years hefore the present hall was built, wrote to the Earl, intimating her wish that he would come to Hardwicke, if the Queen would give him permission.

The national architecture in the 16th and the early part of the next century gradually resolved itself into three distinct styles, each of which was marked by peculiar features. The castellated mansion, which admitted ornamented members upon the gates of entrance and windows, was succeeded by a plaincr exterior, the decorations heing of a less elahorate character. These frequently enormous structures contained galleries of great extent, rooms of vast height. and numerous large windows. Arras tapestry was a coveted furniture, and some of the finest texture is still to be seen and admired at Hardwicke Hall. Spenser speaks of

> ——— "Stately galleries
> Wrought with fair pillars and fine imageries."—RUINS OF TIME, 95.

The predominant style, which, at the end of the reign of James the First, was superseded by Inigo Jones, was formed upon the model of the French palaces, built under the auspices of Henry the Fourth. Burleigh, Hatfield, Northampton House, London, and Wollaton, are conspicuous examples. Hardwicke Hall was only inferior in point of dimensions.

To authenticate the name of the architect who designed and superintended the work, has been, from the absence of proof, an unsuccesful task; and we are assisted only by comparison in endeavouring to assign it to any particular professor. Gerard Christmas, John Thorp, and the Smithsons, father and son, who built Wollaton Hall, in the vicinity, present a probable claim to this monument of their professional talents.

The best architects were usually employed in the provinces in which they had gained their fame. These eminent men in their zenith had been for nearly two centuries eclipsed by the prevailing genius of Inigo Jones, and till the appearance of Horace Walpole's Anecdotes, were sunk in darkness and oblivion. Their works were too vast and magnificent not to command surprise, but their architectural merit, in the succeeding age, was neither understood nor admired. The intermediate period between the disuse of the Tudor and the introduction of the Palladian style, was passed over with neglect, as far as any genuine information of either the architects or their works was concerned. There is a decided analogy in their plans. The general interior design included massy chimney-pieces, reaching to the ceiling, like the sepulchral monuments of the age; and narrow passages which led to grand apartments. At Hardwicke, the furniture is coeval with the house. A conceit prevailed of placing initial letters of the founder, carved in an open parapet to conceal the roof, and here the arms are added. Similar instances are to be found at Wollaton, Temple Newsham, and Castle Ashby. The high wall of hewn stone, with large gateways, surrounding the garden, exhibits similar ornaments.

## Art. IX.—LETTERS TO THE CLUB.

*Odours from Sewer Gratings.*—A correspondent of the *Times* makes the following remarks respecting the effluvia which arise from the open gratings of sewers which are to be met with in every street :—

"The stenches which assail the nostrils of persons passing the open gratings in the streets are most offensive, and must be unwholsome. I think the Water Companies ought to be compelled to open their mains—one and all, simultaneously, at about two or three hours after high water every day in summer and autumn, so that all the sewers might be thoroughly sluiced out and cleansed and discharged into the ebbing tide. The petty dribblings of small channels of water are ineffectual, but the force of a gush of combined streams would be thoroughly cleansing; and the sanitary effect would be very soon felt and acknowledged. The Water Companies are, to all intents and purposes, monopolies, and ought to be subjected to objects of public utility according as circumstances may seem to require. The only "public" benefit they now yield—gratuitously, I believe—is in cases of fire.

"I most decidedly agree with an observation in the *Times* recently, that the water-rates should be much reduced and regulated by Parliament. Whenever "competition" is at work down come the rates, and most obliging and obsequious offers—ay, and entreaties—are resorted to; but no sooner does "combination" take place than up go the rates, and all the obliging manners vanish, except, indeed, in "obliging" very prompt payment."

In most of these remarks I concur, but the readiest remedy, I conceive, would consist in trapping all the sewer gratings, so that the effluvium from the sewers could not rise, and then attaching iron funnel tubes as chimneys to the sewers at suitable intervals, so as to carry off the foul air that would otherwise accumulate there. A pipe should descend from the lower part of the sewer, and then rise up to the level of the street, its upper end being widened to receive a grating. The upright syphon pipe I would make of iron. Some water would continually lie in the lowest part of the bend, which would operate as a trap in preventing the escape of gases, and the perpendicular head of water would be sufficient for forcing through the pipe whatever found its way through the grating. The grating is widened very much at the top, so as to afford more area for the entering water. The Sewer Commissioners would, I think, do wisely to direct their attention to some device of this description : they must be the pioneers of public opinion, instead of laggards in the career of improvement, if they desire to prevent their function from being abolished altogether.

I am yours, &c. S. Townly.

*Boiler Incrustations.*—The Artizan is, I thsnk, the only publication that has spoken otherwise than in praise of Ritterbrand's plan for preventing incrustation by putting sal ammoniac into the boilers. I am not much astonished to find that the Society of Arts has given one of its prizes to Dr. Ritterbrand, but I am astonished that Mr. Gooch, who has generally been considered to be somebody, should have so recklessly identified himself with the system as to have staked his character, in a great measure, upon its success. Now I understamd that it is a fact that the South Western steamer, in which Ritterbrand's plan was tried, and which was puffed off in all the papers as capable, by dint of the sal ammoniae, of going without any blowing off, while the boiler was at the same time kept quite free from deposit, was completely disabled by the introduction of the improvement, though Mr. Gooch did not think this fact deserving of being circulated with equal industry. I have it from a person who saw the boilers of the South Western, after working with Ritterbrand's plan, that they were so completely salted up that the whole tubes of the boiler were concreted into a solid mass, and the salt had to be quarried out, and the whole of the tubes removed before the evil could be remedied.

I do not infer from this fact, however, that sal ammoniac does not diminish incrustation, but only that boilers must be blown off whether sal ammoniac be used or not, and if, as appears to be the case, incrustation can be prevented by blowing off alone, the use of sal ammoniac certainly appears superfluous, whilst its continued introduction into the boiler at short intervals must be both troublesome and expensive. The greatest of the objections to the sal ammoniac, however, is, as you have justly observed, its corrosive action upon the machinery, and this quality alone must suffice to prohibit its introduction.

R. T.—*Southampton.*

*Paddle-box Boats.*—A clause in the Steam Navigation Bill which I imagined had been abandoned, compelling steam vessels to employ paddle-box boats, except where exempted by a license from the Admiralty, has recently occasioned some conversation in the House of Commons and some correspondence in the *Times* between the advocates and antagonists of the system. Your opinion on the subject was given long ago, and is not likely I should think to be affected by the elocution of such authorities as Captain Chappel or Captain Otway. You have already mentioned on former occasions that the paddle-box boats were situated in a most incommodious position, to be available when the vessel was rolling heavily as they are far form the centre of motion, and if after they are launched, the paddle-wheel catches them as in the rolling of the ship, as it will be likely to do, or the engine makes a turn a-head or a-stern, they will probably be capsized. If paddle-box boats be not used, sheet iron boats with air-tight seats and water-tight compartments may be employed, that would be more easily available if judiciously situated, and much more safe when in actual use; and the compulsory use of paddle-box boats would in all probability have the effect of diminishing, instead of increasing, the means of safety. Mr. P. M. Stewart stated in the House, that in Halifax, when it was attempted to use one of the paddle-box boats it was found to have been frozen into its place. I think it very right that all steam vessel should be compelled to carry a sufficient number of boats and a sufficient size of boat for the purposes of safety, but I think it a monstrous thing where the different kinds are equally safe, that Parliament should prescribe on whose plan, or, of whose manufacture the boat should be.

I am, &c. J. Carpenter.

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## Art. X.—SPECIFICATION OF GAS APPARATUS.

SPECIFICATION OF CASTINGS FOR AND OF THE MANNER OF CONSTRUCTING AND ERECTING A TANK REQUIRED FOR THE EDINBURGH GAS LIGHT COMPANY'S WORKS.

The tank is to be made of cast iron plates, of best No. 2 pig iron, 101 feet 6 inches diameter, 20 feet deep, inside measure, besides the breadth of bottom flanges. The bottom to be made of 8 courses of plates; the centre plate to have 8 ribs 4 inches deep, 7-8th inch thick; the plates to be made the size as shown on the plan, all to be 7-8th inch thick. The flanges to be 5 inches broad on the face, 7-8 inch thick, and to be joined together with 1 inch bolts not more than 6 inches from centre to centre.

The sides of tank to be formed of 4 heights of circular rings, each 101 feet 6 inches diameter, inside measure, having 56 plates in each ring; the first course of plates joined to the bottom to be $1\frac{1}{4}$ inch thick; the second course of plates to be $1\frac{1}{8}$ inches thick; the third course of plates to be 1 inch thick; the fourth, or upper course of plates, to be 7-8ths of an inch thick. All the plates to have a slip round the bolted flanges $\frac{1}{4}$ inch broad by $\frac{1}{8}$th of an inch thick, leaving a space of $\frac{1}{4}$ of an inch for jointing. The flanges to be the same thickness throughout as the different plates already described, with the exception of the flange and upright bottom where the side plates are joined, which must be the same thickness as the side plates, and all to be $5\frac{3}{4}$ inches broad on the face. There is a rib to be formed on the plates where the hoops are shown, these are also to be the same thickness as the plate; a small bracket is to be formed on the upright flanges of the sides for the hoops to rest on.

All the flanges throughout to be strengthened by a $\frac{1}{2}$ inch fillet in the corners, and a circular bracket, of a proportionate strength to the thickness of the plates, to be put between each bolt. The bottom and first course of side plates to be joined together with $1\frac{1}{4}$ inch bolts; the second course of plates to be joined together, and to the first course with $1\frac{1}{8}$ inch bolts; the third course of plates to be joined together, and to the second course with 1 inch bolts; the fourth, or upper course of plates, to be joined together, and to third course with 7-8 inch bolts. The distance betwixt all the bolts of the tank not be more than 6 inches from centre to centre.

The bolts all to be made of a proportionate strength, of the best Low Moor iron, with cut screws, so as to work easily, and to be properly lapped on the head with tarred yarn when put in, and to have a plaited lapping on the point, with washers on each of them.

All the joints of the tank to be made or filled up with the best rust mixture, properly hammered into the joints, and made perfectly water-tight.

The entrance and exit pipe in tank to be 24 inches calibre, $\frac{3}{4}$ inch thick, to be cast in two lengths, and to stand 1 inch above the level of the mouth of the tank. A branch to be cast on one of the plates of the outer course of bottom 24 inches calibre, 4 feet 2 inches from the inside of tank to the centre of the branch, and to be 6 inches long, with a flange round the mouth 4 inches broad on the face. The flanges of all the pipes to be the same width, and made fast to each other with 14 $\frac{7}{8}$ inch bolts, and jointed with rust mixture.

The pipe to be connected to the outside of tank with a suitable bend the same strength as the above, 9 feet long. The bend to be joined to the bottom plate with 14 $\frac{7}{8}$ inch bolts, and pointed with rust mixture: a box to be connected to the other end of the pipe in the same manner. The box to be of one casting, with the exception of the lid or cover, which is to be put on with 7-8 inch bolts $5\frac{1}{2}$ inches from centre to centre, and jointed with rust mixture. This box to be 3 feet 6 inches long, 2 feet 8 inches wide, $3\frac{1}{2}$ feet deep, $\frac{3}{4}$ inch thick. A hole to be cast in the one end 24 inches diameter, as near top as the flange of the pipe will allow. Another hole of the same size to be cast in the cover as near to the opposite end as possible. Two 9 feet lengths of 24 inch pipe to be made fast to the cover, as the other pipes already described. All the bolts connected witb this pipe to have proper hemp lappings on bead and points, with washers on eacb of them.

Four malleable iron hoops to go round the tank, as shown on the sketch, and to be made of tbe best Low Moor iron, each to be put on in 16 lengths; 8 of the joinings to be made to overlap each other 2 feet 6 inches, to be thinned off to the ends, and made fast to each other with four 1½ inch rivets. The other 8 ends to be formed so as to be connected witb a gib and key to draw the hoop tight round the sides of the tank. These joints to be made of a proportionate strengtb to the boops.

The first hoop from the bottom joint of side plates to be 2 feet from centre to centre, to be 5 inches broad, 1½ inch thick, and where the joinings are overlapped, that part to be 6 inches broad. The second hoop from the first to be 3 feet apart from centre to centre, to be 4½ inches broad, 1½ inch thick, and where the joinings are overlapped, that part to be 5½ inches broad. The third hoop from the bottom to be 4 feet from tbe second from centre to centre, to be 4 inches broad, 1¼ inch thick, and where tbe joinings are overlapped, that part to be 5 inches broad. The fourth hoop from the bottom to be 6 feet from the third from centre to centre, to be 3½ inches broad, 1¼ incb thick, and where the joinings are overlapped, that part to be 4½ inches broad.

It must be understood that the tank is to be erected on the Company's property on the east side of Lochend's Close. The tank is to be sunk about 15 feet in the ground, and made up with forced earth level with the mouth of the tank. Tbe ground to be excavated at the expense of the Gas Light Company, and the tank is to be put in by the contractor level with tbe ground when finished. The bottom to be properly levelled on a bed of sand, that to be furnished, and the bed made by the Gas Light Company. The ground around the tank to be afterwards refilled and properly beat in at the expense of the Gas Light Company.

The whole work in the foregoing specification, or as represented in the sketch, to be executed in the most substantial and tradesmanlike manner, and to the entire satisfaction of the Directors of the Company or of tbeir Manager, or of their Engineer, or of any other competent person they may appoint; and it must be expressly understood that every expense attending the entire completion of the work, including all carriages and scaffolding, and whatever omissions may have occurred in tbe drawings or specification, these articles must nevertheless be completely finished like corresponding portions of tbe work or other work of a similar nature.

The contractor must satisfy himself with regard to the strength of material, and be must use the best iron, of a strong cohesive quality. To do the castings every justice he must allow them to lie a sufficient time in the sand, and run all risk of every deseription in putting the same work into complete operation; and it must be expressly understood that the tank is the contractor's until filled with water, which will be done by the Gas Light Company, and then to be delivered over by the contractor to the Gas Light Company perfectly water-tight.

The contractor will produce sufficient security for the due fulfilment of the work, and become bound to complete the tank by the first day of June 1847, under the penalty of five pounds sterling for every day afterwards.

Estimates to be given for the tank in one slump sum, inclusive of all the work connected as before specified. The tender to be addressed to Mr. Watson, Manager for the Company, sealed and marked on the back "Tender for Tank," and delivered at the office on or before the 1st day of August next.

Edinburgh Gas Light Company's office 13th July 1846.

Note.—The plan referred to in the foregoing specification lies at the Company's office, 25 Waterloo-place, for the inspection of intending contractors.

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## Art. XI.—WESTMINSTER BRIDGE.

The following resolutions have been agreed upon by the committee appointed to consider the present state of Westminster-bridge:—

I. That the majority of the witnesses who have been examined on the point concur in the statement that the foundations of Westminster-bridge having been originally vicious, tbe bridge can never be permanently sound.

II. That the expense of completing the alterations and repairs now in progress or in contemplation, according to contracts and designs under the superintendence of the Bridge Commissioners, will be very considerable, amounting at the least to 70,000*l.*

III. That this expenditure will still leave the bridge in a state requiring constant attention in respect to repairs, and without any certainty of permanent security; while it will likewise leave the water-way far less adequate to the requirement of the navigation, particularly when the contraction of the stream by the embankment in front of the new palace is considered, than would be the case under a new bridge.

IV. That, irrespective of the approaches, the expense of a new stone bridge near the site of the present bridge, and retaining the present bridge for temporary use, would not exceed 360,000*l.*, according to the highest of the estimates for that object which have been furnished to the committee either in 1844 or in the present year.

V. That the bridge estates would probably furnish a clear surplus of at least 100,000*l.* in aid of the funds for the erection of a new bridge.

VI. That Parliament having by direct grants from the Exchequer (the remaining expenditure having been provided by money raised in lotteries under acts of Parliament) furnished a large part of the expense of erecting originally the present bridge, and having constituted the commission under which the said bridge was erected and has since been administered, and having by sec. 20 of the 9 George II., c. 29, declared that the said bridge shall be extra-parochial, and by sec. 21, that it shall not be a county bridge, maintainable as such bridges are by county-rates, has recognized and sanctioned the principle tbat this bridge, which is tbus by law excluded from other support, shall be maintained, and when needful repaired, restored, and rebuilt, at the expense of the state.

VII. That, in these circumstances, a sufficient case has been made out to justify this committee in recommending to the house that the present bridge be pulled down, and that a new bridge be constructed; and that a bill be brought into Parliament next session to transfer to the Commissioners of Her Majesty's Woods, &c., the estates and property of the Bridge Commissioners, due consideration being had to the claims of the officers of the bridge estates, if their services should be discontinued.

The report is as follows:—

### Part I.—Westminster Bridge.

1. The question to which your committee felt it to be their duty to direct their earliest attention, was the state of Westminster-bridge. The state of the new palace was important to the comfort of the members of the two houses who were to be assembled within it; important to the discharge of the business of the country, to which the committee-rooms existing at the time when the subject was referred to this committee were most inconveniently inadequate, and not unimportant in a pecuniary and economical point of view, when the house shall be pleased to recollect the vast sums paid for such accommodation as has been afforded since tbe fire of 1834, in houses hired in the neighbourhood, or in the temporary buildings erected for the occasion in juxta-position to Westminster Hall. But, though no one of tbese topics was undeserving the attention of the house or of your committee, the first and most urgent consideration was the state and safety of Westminster-bridge.

2. It had been publicly announced in Parliament that it was thought necessary that weekly reports should be made to the Treasury in reference to tbe subsidence or the stability of certain of the piers, and it could not be forgotten that the indications of failure in the bridge in the autumn of 1843 compelled the authorities in charge of it to close the passage to carriages during a portion of the winter of 1843, and for a short period in 1844.

3. As there was no reason to hope that the causes which led to the necessity of that stoppage bad ceased to operate, your committee, on the first day of their meeting, determined to proceed at once to an inquiry, first, wbether there were actual danger, reserving for a later period tbe contingent inquiry; secondly, what, if no such danger were imminent, it might be their duty to recommend, in relation to the general subject of Westminster-bridge. Having ascertained, from the evidence of Mr. W. Cubitt, the contractor for the repairs, that "no disaster is likely to happen for a very long period," your committee felt themselves at liberty to direct tbeir attention to the state and probable progress of the buildings of the new palace. To tbis branch of the subject matter referred to them, your committee will hereafter advert in the second part of this report. In the meantime, tbey pursue the second division of their inquiry:—

4. The practical question which your committee had to decide, in relation to Westminster-bridge, was—whether, under all the circumstances of the case, it were or were not desirable to endeavour to maintain the existing fabric of the bridge, or, on tbe other hand, to pull it down at once, and to substitute an entirely new bridge.

5. The result of the inquiry instituted in the session of 1844, and referred to this committee, proved unquestionably that, without reference to money (*i. e.* assuming that the pecuniary means were forthcoming), every consideration of the convenience of the passage under and over the bridge, and even of economy wben the expense of tbe maintenance of the existing structure is regarded, combined to recommend the removal of the old bridge and the erection of a new bridge.

6. It was stated in substance by several witnesses examined in that year, that the foundations of Westminster-bridge were originally defecsive, and therefore that the superstructure could never be made as effectively secure as if the whole were now rebuilt on an improved plan.

7. Even irrespective of the particular vice of the foundations, the character of the soil on which the bridge is built was sufficiently illustrated by the late Mr. Telford, in the following passage, describing one of his own operations on the site:—"I then proceeded to ascertain the nature of the matter of which the bed is composed, and on which the piers rest; and I found tbat an iron rod was easily pressed by hand through sand and gravel to the depth of 6½ feet below the surface of the bottom of the river, or 3½ feet below the bottom of the platform; how much lower a longer rod might have penetrated I had not an opportunity of trying." And as to the

foundations, Mr. James Walker, civil engineer, who was at that time, and still is, the professional adviser of the Bridge Commissioners, stated in 1844, "All the defects of the bridge have arisen from the imperfect foundation of the piers." In his original report to the Commissioners of Westminster-bridge, seven years before, namely, the 28th of February, 1837, Mr. Walker, after having stated, "that for every useful and ornamental purpose a new bridge would be preferable, if the funds will justify the expense," proceeded to state the facts and reasons which led to such conclusion; namely, "that the piers of Westminster-bridge were built in caissons, without bearing-piles under them; that the bed of the river, for a considerable depth under the caissons, is loose gravel, and that the effect of the removal of the piers and dams of London-bridge is to increase the velocity of the ebbing current, and to deepen the channel between the piers, and thus to endanger the foundations." After the experience of nine years, Mr. Walker, reviewing the whole case, and being requested to state his opinion "as to the perfect stability of the existing fabric of the bridge," says, on the 19th of May, 1846, "After that bridge has sunk and twisted about in the way it has done, from the commencement of its building to the present time, I have seen enough of it not to risk anything like a professional opinion upon it," *i. e.* its perfect stability. . . . "I feel with reference to Westminster-bridge, that it is like a patient whose constitution I did not make, which has been in the hands of doctors from the day it was built to the present time." Mr. Walker added, indeed, on the same day, "I do not think that there is any reasonable expectation of anything like a sudden failure of the bridge that would cause public danger; but when it is considered what an immense stake there is, in the case of any accident happening to the bridge, to be set against the taking of the thing boldly in hand, and making a complete job of it at once, to use an expression common with us, I must say, as I have said from the beginning, that it is nothing but a deference to the Lords of the Treasury which would in my own mind make it politic at all to expend a great deal of money upon the repair of the old bridge." Mr. W. Cubitt, civil engineer, stated in 1837, in his report, "it also appears from the history of this bridge, that the foundations, as at present existing, were designed and calculated for much smaller piers, with a light wooden superstructure for a bridge; which plan was afterwards changed to that for the present stone bridge, and carried into effect upon the original foundations, by casing or lining out the piers, and surmounting them with heavy stone arches." Under these circumstances, it is not surprising as was stated in a contemporary work, which describes the erection of the bridge, that "before the bridge was even finished, viz., in 1747, the third pier from the centre, viz. the fifth from the Westminster shore, began to sink; so that the two arches which rested on it departed from their circular figure, . . . . and some of their principal stones fell into the water." (*Gephyralogia*, 1751, p. 111.) The remedy applied in the first instance, according to that authority, was to lay such a weight on the pier as to sink it gradually to the level where it might find rest. Accordingly a weight, "amounting to 12,000 tons," was laid on the sinking pier, apparently to sink it lower; and it "continued sinking several months after the weight was laid on." Three whole years was the use of this noble structure retarded by this accident,"—pp. 111, 113. It is true, however, as the late Mr. Telford observed, in a memorable report which he addressed to the Commissioners of Westminster-bridge, on the 12th of May, 1823, that "the dangerous instability of the piers of Westminster-bridge seems to have passed in oblivion." It is true, also, as Mr. James Walker observed in his evidence, that "in the course of 90 years the fabric had come to a state of repose, comparatively, until old London-bridge was removed, the effect of which was to increase the velocity of the tidal current. This deepened the ground under the bridge; and the piers being thus deprived partly of lateral support, and some of the fine sand also getting from under the caisson bottoms, they began to be restless again."

8. The cause of the original failure in 1747 was the omission of driving piles under the piers; but the miserable economy of saving 5,000*l.* or 6,000*l.*, for which Mr. King (whose name ought to be thereupon preserved in honour) offered to execute the work, prevailed, though it was "not one part in 60 or 70 of the whole expense of the bridge." (*Gephyralogia*, pp, 96, 97). Hence the first failure, and hence all the subsequent weaknesses of the structure, and the enormous expense of make-shift repairs.

9. When engineers like the late Mr. Telford and the present Mr. Walker suggest a remedy for an evil, occurring in the line of their own profession, and in matters daily under their eyes, those who have not the advantage of their science and experience ought to be slow to pronounce an opinion unfavourable, *à priori*, to any suggestion so made. Mr. Telford recommended that, as piles had not been originally driven under the piers, "piles should be driven round the piers, using the diving-bell for placing them and cutting them. A number were done in this way, but even those that were done did not seem quite at rest; and the commissioners, from the expense, uncertainty and delay with which the operation was attended, seemed, before I was called in," said Mr. Walker, in his evidence, "to have resolved for a time at least, not to enclose any more of the piers in the way I have described." Then came the system of coffer-damming. "My decided opinion is" (said Mr. Walker, in his paper E in App. No. 1 of Report of 1844,) "that coffer-damming is the best plan;" and that plan was thereupon adopted; but while Mr. Walker discontinued Mr. Telford's use of the diving-bell, and did not concur in Mr. Cubitt's plan of paving the bed of the river, Mr. Cubitt, on the other hand, equally condemned the use of coffer-dams in the case of Westminster-bridge; stating distinctly in his paper F, in the same Appendix, "That in the case of Westminster-bridge, the original construction and present state of the foundations are such as will not admit of the coffer-dam plan being carried into effect with safety to the bridge, or a well-grounded certainty of a successful result." Between these two discordant authorities, the commissioners made their election, and adopted Mr. Walker's plan of coffer-damming, and in the course of the following year entered into contracts for completing it.

10. It is due, however, to both gentlemen to state that, even in 1837, they each recommended a new bridge, if the pecuniary means could be found, in preference to any attempt to repair the old structure. Mr. Cubitt stated, "that there is no doubt but a new bridge would cure all the evils complained of." And Mr. Walker enumerated those considerations which "would probably turn the balance in favour of the new bridge." At a later period, the committee of 1844 received from that gentleman this further statement: "Without hesitation, I say there is no art that can make the piers of this bridge so secure as I could have made a new one." Nevertheless, upon a review of all the case, he added:—"I did not doubt as to the security of the whole superstructure. When I say this, I must at the same time allow, that the sinking which has taken place in the 17-feet east pier, after the water was admitted within the coffer-dam, is a drawback," meaning, of course, the only drawback, "which has at all raised a doubt in my mind;" a sinking, be it remembered, which has gone down 9 inches, and has left that pier 3 inches out of the perpendicular; but ever since last October that pier "has been, as every other part of the bridge has been, perfectly motionless: and therefore I have reason to think that the cause which created that movement in the 16 and 17 feet piers is at an end, and that these also are secure." At this time the 16-feet pier had gone down 2 inches, and the 17-feet pier 9 inches; "all the piers," indeed, "sunk a little during the operation of driving the piles."

11. The confidence, however, or to use Mr. Walker's words in another place, "my faith, which amounted to conviction (previously," *i. e.* to the sinking in October, 1843), "was somewhat shaken" by that sinking; but he adds, "It is proper also to say, that my confidence has revived by the entire freedom from all movement since that time," viz., up to the date at which he was then speaking, June 10, 1844. If, however, the confidence revived, solely because the piers had ceased to sink, it must, of course, die again when they again began to sink. And this is the fact. The sinking has begun again; and though in no one week considerable, or indeed observable except by very nice tests, yet the aggregate sinking in the course of many weeks becomes perceptible to the eye; and, above all, as it is progressive, must, at some period, terminate in the destruction of certain portions of the bridge, even if it do not endanger the whole fabric. So early as 1837, Mr. Walker's recommendation to the commissioners, as already seen had been to build a new bridge, if the founds could be obtained. On the 7th of May, 1845, he stated to the commissioners, still more strongly—"to the reasons I then gave for recommending the new bridge, there is to be added the bad foundation which has caused the sinking in the two piers; for even half an inch in two years is enough to prove the want of perfect stability, and to weaken that confidence which I ought to feel in order to justify my recommending an outlay of 100,000*l.* in addition to the 90,000*l.* already expended. I have before stated, that all the other piers, which have been finished, are secure; but two piers on the Surrey side next to the defective piers remain to be coffer-dammed round and piled; and if the sand under those, too, be of as loose a nature as those adjoining, they may cause further trouble and expense. Should they require to be taken down the difference between the partial plan" (*i. e.* continuing the system of repairs) and the entire renewal" (*i. e.* the removal of the old bridge and the construction of a new bridge) "will be considerably lessened." The causes which induced Mr. Walker to recommend a new bridge in 1837 and in 1844 and in 1845, have not ceased to operate. The sinking of the 17-feet pier since the 7th of May, 1845, to the 19th of May, 1846, has been $1\frac{3}{4}$ in., aud in the 16-feet pier about $1\frac{1}{2}$ inch; and it continues in both. By the report of Messrs. Walker and Burges to Mr. John Clementson, Secretary to the Bridge Commissioners, dated the 20th of July, 1846, and included in the appendix, those gentlemen state they have "this day taken the levels of the piers of Westminster-bridge, and have to report a further sinking of 2-10ths of an inch in the 17-feet east pier, and 1-10th in the 16-feet east pier, since their report of the 6th instant."(July 6, 1846.) They go on to say, "The movement of 2-10ths of an inch in the 17-feet pier is double what we have had occasion to report for a considerable time. The continued sinking in the two piers has affected the stones of the 72-feet arch which rests upon them, an open joint being perceptible in the soffits between two of the courses near the crown, and one of the south-face stones having dropped down about half an inch." Messrs. Walker and Burges concur, accordingly, in the statement, "That a way or thoroughfare over the river at Westminster, consistently with the safety of the public, can be best secured (or perhaps we ought now to say, can be secured only) by a temporary bridge, and that no time should be lost in proceeding with it." More than a month earlier, viz., on the 11th of June, 1846, Mr. George Rennie

gave in substance the same opinion, viz., that no time should be lost in making arrangements for the construction of a new bridge; and being asked, "Might not the present bridge serve as a temporary accomodation while another bridge is being constructed?" he replies, "It might:" but he adds, "with all the chance belonging to it."

12. It is true that Mr. Cubitt, the contractor, whom your committee felt it to be their duty to call as their first witness, inasmuch as the New Palace was a matter, as has already been observed, of comfort and convenience to the two houses of Parliament only, whereas the safety of the bridge was of paramount importance to hundreds of thousands of the Queen's subjects, stated in answer to the second question, "I do not apprehend the bridge to be otherwise than safe." . . . "I do not mean by that that it is in a state of perfect stability; that there may not be from time to time slight settlements in it; but I am very strongly of opinion that no settlement will ever take place to a degree that should endanger the public safety."

The same witness, indeed, had stated in 1844 that he thought the bridge "may last for two or three centuries;" "that the bridge with a very moderate repair from time to time is capable of carrying the public safely for centuries to come;" and he added, accordingly, "I know no reason why it should be pulled down."

13. On the extent, however, of the knowledge of the witness as to the facts connected with Westminster-bridge, it is due to the other gentlemen who gave a very opposite opinion to state, that Mr. W. Cubitt, being asked (Q. 810,844) whether he can state the depth of the river at Westminster-bridge now, as compared with its depth before the removal of old London-bridge, answered, "I cannot;" and being further asked, "Have you ever understood that it has already (1844) deepened as much as five or six feet?" replied, "I have never heard such a thing: if that has been stated, it can only be in one particular place, where, from some cause or other, there has been a gullying out by a peculiar current:" and when again asked, "You are not, however, aware of the depth which has been given to the river by the removal of old London-bridge?" he replied, "I am not aware of it; but I am pretty sure that it has not given an average of 18 inches." The committee understood, of course, that in this answer Mr. W. Cubitt was speaking at the time of the locality in question, namely, Westminster-bridge, and not of the Thames at Staines or Wallingford; and therefore proceeded to put the following question:—"You conceive that anything less than an average of five or six feet would not endanger the security of the sheet-piling round the piers, by which they are surrounded?" to which Mr. W. Cubitt answered, "I rather hesitate in giving the precise line: if it came to five or six feet I should begin to feel uneasy, if I was sure it ever came to that." It appears by sections of the river taken by Mr. George Rennie, and laid before this committee, and ordered to be inserted in the appendix to this report, as furnishing a very curious and interesting view of the changes produced by natural causes in the bed of the river, that between 1823 and 1835 the river, 50 feet below Westminster-bridge, had deepened between six and seven feet; proving the tendency of the river to "engineer for itself," to use Mr. Page's expression, to a greater degree than was previously anticipated; and this measurement near Westminster-bridge proves that the very case had happened which, as Mr. W. Cubitt stated, would have made him "begin to feel uneasy," namely, that the bed of the river had there deepened at least five or six feet; in fact, it has done more, inasmuch as, "by a longitudinal section of Westminster-bridge which appeared in appendix 15, G. 1, to the Report on the Thames Embankment, and upon which," said Mr. George Rennie in his evidence, A. 1513, "I have coloured by a dark line the existing bed of the river in May, 1846, it will be seen that the sixth and seventh piers from the Surrey side have their foundations exposed eight or nine feet."

14. On the whole subject of the effect which the deepening of the river, or any other cause, may have had in unsettling the foundations of Westminster-bridge, and consequently its superstructure, your committee feel it to be their duty to recal two circumstances to the attention of the house; first, the settlements which did take place in the autumn of 1843, which, as already noticed, caused the bridge to be closed and shut up for carriages during a portion of the winter following: and secondly, that the favourable answers already quoted as to the stability of the whole structure depend on the assumption that the whole structure is to be subjected to the same process and system of repair which has already been applied to parts. Now, the amount of the contract—remaining so to complete the repairs—was, in 1844, 52,870*l.*, together with a further sum of 40,000*l.* to make the bridge of the same width as London-bridge. This aggregate of 92,870*l.* was therefore necessary, in 1844, according to the then views of the commissioners to the repairs of the existing bridge, and might have been saved accordingly, and made applicable to the construction, in part, of a new bridge, if the repairs had been then discontinued, and if a new bridge had then been substituted.

15. In addition to this, it must never be forgotten that Mr. W. Cubitt, being the contractor for the works commenced in 1838, gave evidence as strong as that of any other witness on the question of the original vice of the foundation. In 1844, he referred "to the original defect in the surface of the foundation;" adding, in A. 595. "I mean that it never was correct or proper." "There was one pier which had always been called the sunken pier; that was the one they were obliged to unload when the bridge was first built. Then those two other piers in the bridge which were called sinking piers: they had that name given to them because they had been in the habit of sinking more than the others." A. 638. And being asked, in reference to a subsidence of 9 inches in one of the piers, whether such subsidence shakes his belief in the future stability of the fonndation, he replies, "I always had an impression that the bridge would be liable to sink a little;" and, being further asked whether—"When you say 'a little,' do you consider 9 inches a great or a small subsidence?" he replies, "I consider 9 inches to be a great deal; but, with reference to an arch of that form, and with stones of that thickness, it is of very little importance with regard to the safety of the bridge." While, however, Mr. W. Cubitt states that, so far as the original defectiveness of the foundation is concerned, the bridge is sufficiently stable for all purposes for which it is required, that no disaster ever can accrue by which the public would be damaged from that cause, he does not retract his preceding opinion (1), "that the bridge always must be an imperfect structure" in reference to the mode in which it was built; and (2), though he may contradict the opinion of others, he cannot gainsay the fact, that the bed of the river has been gradually deepening, and the foundations of the bridge abraded and laid bare in consequence: and your committee feel that if this be so, Westminster-bridge cannot be "as stable as it ought to be."

16. The very remedies, indeed, which have been applied to strengthening the foundations of the piers may, in fact, have loosened them, by loosening the ground on which they rested. Even so early as the 16th of May, 1823, the late Mr. Telford himself admitted, in reference to his own suggestion of sheet-piling, "I believe I did not sufficiently explain that by driving piles through loose sand and gravel the matter is always disturbed, and during the operation of driving, liable to be washed away, and of course to produce more risk to the piers than if left undisturbed." And Mr. W. Cubitt being asked, as the contractor engaged on the work, "Can you state to the committee whether it be or be not the fact, that every pier, as has been alleged, with only one exception, sunk more or less after the sheet-piles round it to secure the bottom of the caissons from being underwashed by the general deepening of the river were driven?" W. Cubitt replies, "They have not all sunk;" and being thereupon reminded, "The question implies that one was an exception; do you wish the committee to understand that all the piers, with one exception, have sunk more or less since the piles were driven?" Mr. Cubitt answers, "I am not prepared to state positively that they may not all of them have sunk a little. I am not quite sure but that they may have sunk an inch, or half an inch, or some very slight thing; but one of them sunk 9 inches and another sunk 2 inches." And as to the future, Mr. W. Cubitt had already stated his "previously formed opinion, that the bridge was not, in any part of it, in a state of perfect steadiness; that it might always be liable to subside a little from the defect of the foundation."

17. The result of the whole question connected with this species of repair is stated by Mr. Walker in answer to question 89 of 1844:—"Do you think that the bridge will now be brought to a state of as perfect security and stability as a new bridge, if you were called upon to construct it?"—"Certainly not." And in answer to the next question, "Do you think that by any resources of your professional art, this bridge can be brought into a state of perfect stability and security as compared with a new bridge?" Mr. Walker replies, "Without hesitation, I say there is no art that can make the piers of this bridge so secure as I could have made a new one." It is right, however, to add, that Mr. Walker stated, in his examination this session, "that the measures which had been adopted had been completely successful in preventing any further movement in 6 of the piers: . . there has been no movement since" (*i. e.* since the 7th of May, 1845) "in any of the piers, except the two I have already referred to." Nevertheless, in answer to the question (Q. 1350,) are you or are you not of opinion that, with a due regard to the public convenience, and to avoid danger, arrangements should be made, without loss of time, for building a new bridge?" Mr. Walker's answer is distinct; "Certainly, without reference to Money, I say 'Yes.'

18. As to the mere durability of the bridge, by which the committee understand the perfectness of the masonry both in the arches and in the piers, excluding always the question already discussed as to the stability of the foundation, there appears no reason to doubt the accuracy of Mr. Walker's opinion,—"There is no part of the work which will not last for ages;" but a qualification to this opinion must here be given on the authority of Mr. Walker himself, who, in 1837, stated as follows:—"From the piers being intended originally to carry a wooden bridge, and being cased round when a stone bridge was resolved to be substituted, and from the very bad quality of the masonry, the superstructure never can be made a very secure and solid work;" and, even admitting the superior accuracy of his later opinion, when, during the interval, he had had fuller opportunities of examination in relation to the durability of the superstructure of the bridge, it is obvious that this admission does not at all establish the expediency of maintaining the present bridge so long as the first and main question as to the sufficiency and stability of the foundations on which the structure rests, remains in a state so unsatisfactory as at present.

19. It was not contended in 1844 that the bridge was then in a "perilous"

state. Mr. Walker expressly repudiated the word; and even before the new system of repairs, he had stated, "that the bridge is not in immediate danger;" and Mr. W. Cubitt, the civil engineer (and not the gentleman of the same name who is the contractor for the bridge), being asked in reference to the state of the bridge when the repairs should be completed, "Your conclusion is that the bridge will be an insecure bridge?" replied, "A very doubtful one." "You will not say it will be an insecure bridge?" "No." He had been previously asked, "Do you regard it possible, that any talent and any expenditure of money, could make the foundations of Westminster-bridge as secure, under existing circumstance, as the foundations of a new bridge could be?" and replies, "Certainly not." Mr. Cubitt, civil engineer, further states, that "from what I have seen, I would rather build a new bridge than spend more money upon this, seeing it has done exactly what I expected it would do when I made my report in 1837. My opinion is, that it is best not to go on spending a great sum of money to repair and widen and beautify this bridge, which never can be good either in its roadway or in its foundations. Therefore, under all the circustances, the bridge having proved to be too heavy for the nature of the clay it stands upon, it being very difficult to protect it without piling and paving, I say, as an engineer, that the best thing is to dispense with all further repairs, and make a new bridge. I said so before, and Mr. Walker said so also, and I am comfirmed in that by what has subsequently taken place." And when asked in the next question, "You consider the only question to be one of finance?" he replies, "Certainly, the bridge is a mass of rubbish. The piers and the masses of masonry and rubble were first built for a wooden bridge, which was afterwards converted into a stone bridge, and heavy arches were put upon that which was not more than strong enough for a wooden bridge. . . . . . The small piers were then cased round to make them larger, and springings were made for stone arches, and a very heavy bridge was put on those foundations."

20. Though Westminster-bridge so constructed—without piles and on the imperfectly-levelled natural bed of the river—did actually fail during the construction, yet, "after it was constructed, and the arches which had failed were rebuilt, it stood for some 60 or 70 years unmoved." On the removal of the dam caused by old London-bridge, "a wider passage was opened to the Thames, and the foundations of the arches underneath Westminster-bridge began to wear away, so much so, that they caused a great apprehension of the bridge falling; and from time to time they were repaired by the diving-bell, and various other modes. Mr. Telford was called in, and advised stones being thrown in; and he advised also to pave underneath the arches between the piers, so that the bottom might not be washed away. After his death, the commissioners did me the honour to call upon me to advise them. I considered the thing, and felt quite aware that disturbing the bottom would not be a good thing; but that if we could continue the bottom exactly as it always was, the bridge would stand the same as it had done; that there would be nothing to prevent it; and to do that, I propose to pave with large stones, two feet thick; . . . . to pave a perfectly flat floor down as low as the frames which form the foundations and have been carried into the soil." . . . "I proposed paving under the whole of the bridge, and 50 feet parallel along it, above and below, so as to make a perfect stone pavement; with such pavement the bottom never could have washed away; and without washing away, the piers would not have fallen down."

21. A suggestion made by such an authority as Mr. Cubitt, civil engineer, is of course entitled to just attention; but your committee, after bestowing that attention upon it, feel bound to state two objections to it, which, in their judgment, are insuperable. They relate to the effect of the plan upon the navigation, and to its cost. The one may be conveyed in the admission of Mr. Cubitt himself—"The only disadvantage (if disadvantage it can be called) of this plan is, that it limits the depth of the navigation under the bridge to the level of the stone paving; but as this would be greater, by about 3 feet, than originally existed, and till after the removal of the old London-bridge, I imagine that no complaint could arise on that head." The answer to this observation is, that those concerned with the state and probable condition of Westminster-bridge have to deal with the river and its actual depth in 1846, and not with with its depth in 1823; and must not forget that if the river has deepened under the arches, say 6 feet, the proposed plan of raising a pavement of something like 3 feet, would take away a depth of 3 feet from the actual navigation. The second objection is, that, irrespective of all repairs to the bridge, and leaving that bridge as it is, the probable cost of the paving would, in Mr. Cubitt's own opinion, be about 120,000*l*. It is not necessary, therefore, to pursue this subject.

22. Another remedy was proposed by another gentleman, Mr. William Hosking, architect and engineer, and professor of the principles and practice of architecture in King's College, London. While he differed from other witnesses on some important points, and especially in his belief that "the present foundations might be rendered sufficiently secure to be entrusted with a new superstructure were not an unnecessarily heavy one," he concurred with almost all in the opinion that the present bridge cannot be made "permanently available," to use his own words, "without the bar or weir I have spoken of, which I consider to be an absolute essential to the security of the existing foundations." Now, inasmuch as the bar or weir in question is, in the judgment of the same witness, a necessary precaution "at the other bridges" also (A. 505), as otherwise "all the other bridges will be undermined as well as Westminster-bridge" (A. 502), it is clear that his remedy must be viewed in relation to the whole of the river as it flows through the metropolis; and, irrespective of the objections to which the plan, if ever adopted in any one breadth of the river, would be liable as an obstruction to the navigation at that part (which, even the witness admits, it certainly would not improve (A. 512), and so on, wherever adopted, the ultimate expense of making successive weirs above each bridge would be obviously immense; and your committee—to confine themselves to the consideration of this project in relation to Westminster-bridge alone, the immediate subject referred to them—cannot recommend any further attention to it.

23. However wonderful as a structure Westminster-bridge was regarded at the time of its erection, and there is reason to believe that at that time it was the longest stone bridge which covered water all the year round, not in England only, but in Europe, Mr. Hosking expresses an opinion, in which your committee fully concur, "that a bridge, in every respect better, would be produced at the present time by almost any man of moderate ability who is conversant with the subject."

24. On the general subject, both of the present state of the bridge, and of the expediency of substituting a new one, other professional gentlemen, of the first character for skill and for experience, give evidence to the same effect.

25. Mr. Rendel states, "I should be very indisposed to risk any professional reputation upon giving to the present structure that permanent character which is adverted to."—"The foundations are wholly different from the foundations of any other bridges across the Thames."—"I do not believe that any talent or any skill, or any application of that skill, could, at a cost which I should call justifiable, give to the present bridge that security which its importance demands."

26. Mr. George Rennie states, "I should decidedly condemn the old one (the bridge), and recommend the expediency of its being pulled down, regarding it as an engineering question entirely."—"Setting aside that (*i. e.* money), I should condemn the present bridge decidedly, and have a new bridge; not only that, but you may be liable to very considerable further repairs besides those at present contemplated."—"I have no other observation to make, but that I consider it a great pity to devote that money to the repairs of an old structure which might and ought to be devoted to a new one, on the ground of the insecurity of the present bridge, and that there is no safe guarantee for the money laid out upon it being properly spent." In his evidence before your committee this year Mr. George Rennie stated that he retained precisely the same opinion;—"I think it would be throwing away good money after bad to attempt to repair the bridge so as to make it a permanent structure." The removal of from 20,000 to 30,000 tons, as stated by Mr. James Walker in 1844, in order to lighten the vertical pressure upon the piers, by means of the abstraction of that material, has, in Mr. George Rennie's judgment, not succeeded in preventing the further subsidence. In fact, the further subsidence is stated distinctly in the evidence of Mr. James Walker of this session.

27. Your committee could readily extract, for the more easy consideration of the house, numerous other passages in the evidence of 1844; but they have perhaps sufficiently selected some of the most striking answers which have been given to the inquiries made on the subjecs of Westminster-bridge; and they leave the remainder, without further selection, to the attention of the house. But they cannot conclude this collection of extracts from the evidence of 1844 without adverting to the fact, that the witnesses who depose the most explicitly to the propriety of removing the existing bridge are men of the highest engineering talent and experience in the empire; while the only witness, however excellent and respectable in his profession, who gave in that year any testimony in favour of maintaining the present structure, is the contractor employed to repair it.

28. Mr. Walker, while, as already stated, he repudiated the word "perilous," as applied to the bridge, distinctly stated that the want of money for a new bridge would alone induce him to propose the continuance of the actual structure.

29. When examined in the present session, Mr. Walker admits that, so far as regards one of the piers, "My opinion of being able to make the bridge perfectly secure has not been a correct opinion, as far as it is shewn at present. There is to be set against that the expense to which the Commissioners have been put, in repairing and strengthening the other piers; but, on the whole, my opinion is now, that, but for the question of expense, the better way is, under all circumstances, referring to the improvement of the situation, the future stability of the work, the giving an easier approach, an easier inclination, a wider bridge, a better waterway, and an improved navigation by a smaller number of piers, the safer and better course is to rebuild the bridge."

30. This answer well embodies the chief considerations which induced your committee to recommend, by unanimous resolution, the removal of the existing structure, and the substitution of an entirely new bridge.

31. Other considerations, however, have not been without their weight on the minds of your committee in the resolution which they adopted. The

traffic over Westminster-bridge has greatly increased within the last few years, "so much that it is difficult at times to get over it." It is obviously immense. Sir James M'Adam stated, in 1844, that he had been directed to cause to be counted the number of horses which passed Charing-cross annually, and that it had been ascertained that it was 6,600,000; and though there was no record of the proportion which passed over the bridge, he added, "I consider that the larger proportion of that thoroughfare, particularly the heavier carriages, passed over the bridge." It is further in evidence that the inclination of Westminster-bridge was, in 1844, probably greater than that of any bridge over a tidal river in England; that its inclination was at its commencement, *i. e.* for a distance of 50 yards at each end of the bridge, about 1 in 14½, and about 1 in 33 for the remainder. It is true that the inclination has been reduced since 1844, but it has been reduced by the sacrifice of a quarter, at least, of the carriage-way of the bridge. As a general principle, it is clear that the wear and tear, both of the animals which draw a carriage on a steep inclination, and of the surface of such inclination itself, must be considerably greater than on a level, or than on any road-way in proportion to its approach to a level. When, in addition to this, it is recollected that, in the course of the system of repairs recently adopted, and for the purpose of lightening the vertical pressure on the bridge, such a mass of stone has been displaced as has reduced the present surface of the road by a depth of 5 steps below the footpath on both acclivities, and that the carriage-way has thereby been contracted about the width of a carriage, it is sufficiently evident that, almost in the measure of the increase of the traffic, has the accommodation for its passage over the bridge been diminished.

32. When, further, it is recollected that the headway under the existing Westminster-bridge is lower than the headway under any of the bridges in the metropolis, and until reaching Battersea, it is clear that, as favouring the navigation of the river, it has no special claims to consideration.

33. The committee of 1844, whose report has been referred to the consideration of your committee, took evidence on the question, whether in the event of its being decided to pull down the present structure, and to erect a new bridge, the material should be of iron or of stone; and if of iron, whether in suspension or in the form of arches; and if of stone, whether of granite or what other material. And your committee, in the present session, examined at some length both Mr. George Rennie and Mr. J. Walker on this general subject. Your committee do not feel it necessary either to analyze this evidence, or to come to any formal conclusion on the subject, except to recognize the two following propositions—namely, (1) that a suspension bridge, though affording greater facilities to the navigation than any other form of bridge, is inexpedient; and (2) that, irrespective of expense, a granite bridge is expedient. On the first point, Mr. George Rennie compressed into one sentence the whole question :—"The great inconvenience of suspension bridges is, that they are always at work, that they are always in a state of degradation; whereas, bridges by compression are always in a state of equilibrium." The illustrations which he gave will well repay the attention of the house. On the second point, it is clear that, in proportion to the strength of the material, may be its thinness; and a greater waterway can be afforded by an arch of granite than by an arch of Bath stone. From this gentleman, from Mr. Walker, from Mr. Barry, and from Mr. Page, your committee have received designs for a new bridge, and have directed them to be lithographed and placed in the appendix. All have great merit, and perhaps the one which possesses the least, might, if it stood alone, have satisfied every requirement. But your committee do not feel it within their province to give any opinion on the relative value of these productions. They do not, however, consider it to be inconsistent with their duty to recal to the attention of the house a suggestion applicable to the erection of all public works; it was made to the committee of 1844 by a gentleman already cited, who appeared to have given particular attention to the subject. The substance is stated in the next paragraph.

34. On the mode by which, through such competition as might best secure the application of the first talents to the production of the best designs, and might thence enable some superior authority to select one from all, or to combine different parts from two or more, Mr. Hosking stated as follows (and your committee concur generally in his opinions) :—The essential matters should be defined by the proper authorities, in the first instance, and before attempts are made to obtain designs. A specification of what is required should then be made; and this should be more or less particular, as it may be determined either to fix a sum of money as the limit of expense, or, on the other hand, to receive designs with reference to the object, and without limiting the expense. Such a specification should be put into the hands of a reasonable number of competent practitioners, with a request that they would each make a design for the contemplated work in accordance with the stated conditions. All the designs so obtained may be examined and investigated with the advantage of the presence of their authors to explain what they may have intended, and to correct what may be misunderstood. In this manner the best energies of competent men would be applied to the work, and it is probable that the best results would follow. . . . A general competition would end in general disappointment, . . as none of the persons who would be recognized as most competent would send designs without being specially applied to for them. . . . At the time London-bridge was in contemplation, advertisements were issued for designs, with offers of some three or four premiums. Drawings were sent accordingly by 70 or 80 persons, and premiums were awarded to the three or four which were said to be the best designs, but not one of them was used; they were immediately thrown away, and a design was taken up which had not been in the competition; but which, indeed, had been in the hands of the Bridge Committee beforehand, and the author of which was already dead. The late Mr. Rennie's design was executed. In order to avoid this apparent invidiousness and unfairness, and to secure the real benefits of a competition among competent men, the selection of the architects and engineers should be limited and each should receive a certain remuneration for the work which he might send in. No man can afford to work for nothing. Every design asked for should be paid for; and no one ought to be asked, either directly or indirectly, to make a design unless it be intended to pay him for it. If this system were adopted the property in the designs so sent in would belong thereafter to the authority by the directions of which they had been sent in, so that the good parts of one design might be accommodated to the good parts of other designs, and the combined result of the whole would be something superior to that of any one individual design. This is one of the advantages from requiring designs from persons of known ability, and paying for them, so that all the designs obtained may be turned to account. It is the parties seeking designs, and who desire to derive advantage from the application of many minds to the same subject, that are to be benefitted; and they who seek a benefit must be contented to pay for it. It can never happen but that in several designs for the same thing there will be some points or parts in some of the designs, other than that which may be generally the best, better than the same points in the best design. When all are paid for, all may be used; and the best design in a "concurrence" may be greatly improved by the incorporation of the excellencies of the others.

35. The house will observe that your committee, in their resolutions herein adverted to, have not pronounced any opinion as to the precise site of the new bridge; but it is obvious that, while many considerations might be urged for the removal even to a distant position, other considerations, entitled to the highest attention, might be adduced in favour of the existing line, or one in immediate juxta-position to it. It has been suggested by a high authority that it would be very desirable to remove the bridge to the south of the Victoria Tower, thereby opening a more direct communication from the region of Belgrave-square to the right bank of the river, and generally to Lambeth, Southwark, and London-bridge, and the railway termini now established in its neighbourhood, or hereafter to be so established. It has been also suggested, as a consequence of such removal of Westminster-bridge, that a new bridge might be thrown over the Thames at the east of Whitehall-yard, with an access from Charing-cross, and another access from the Horse-guards. But independently of the objection, more or less valid, of disturbing the present traffic from Charing-cross to the north, and from George-street, the rest of Westminster, and the Parks to the west, your committee think it right to refer to the evidence of Mr. Rendel in 1844 :—"I do not believe that there is a part of the Thames better suited for a bridge, by which I mean a permanently founded bridge, to stand upon, than the site of Westminster-bridge." It is right to add, that the approach to the actual bridge from the left, or Middlesex bank of the river, is carried along Bridge-street, almost the whole of the property on the north side of which is part of the Bridge Estates: and therefore, that a new bridge, on the existing site, would be erected with little sacrifice of that property; and that a new bridge erected to the north of the present structure, that is, further down the river, and at a better point of view for regarding the New Palace, need involve no other sacrifice of the Bridge Estates than that of the 10 houses forming part of the north side of Bridge-street, and without any considerable outlay in the purchase of the other houses on same side. In connection with this consideration, it was at one time assumed, that there was no prospect of permanently preserving the present bridge; it might, nevertheless, continue available for the temporary passage over the river, while the new bridge was in course of erection in juxta-position to it on the north. But Mr. Walker urged, in the spring of 1845, the erection of a temporary bridge as even at that time desirable; and he has urged it with increasing earnestness in the course of the present month of July, 1846. His report (that of Messrs. Walker and Burges) is printed in the appendix. He estimates the first cost of a temporary bridge, of which he has prepared a plan, which is lithographed in the appendix, at 40,000*l.*; and he considers that a certain portion of that expenditure might be recovered by the sale of the timber forming the materials of that temporary bridge, when the new bridge shall be opened; and that the remaining portion of the cost of such temporary bridge would be met by the value of the materials of the existing bridge, if used up on the spot.

36. Your committee will now proceed to consider what means remain in the hands of the commissioners of Westminster-bridge, in aid of the expense of a new structure, and what, in the first instance, is the constitution of the commission itself.

37. The management of Westminster-bridge is in the hands of 94 commissioners; 26 sit by virtue of their offices; 57 by virtue of their seats in the House of Commons, as representing the metropolitan counties; and 11 sit as elected by virtue of the Bridge Act, 9th George II. The annual

expense of that management, irrespective of the expense of repairs, is, in salaries,—

| | £. | s. | d. |
|---|---|---|---|
| Treasurer ... ... ... ... ... ... ... ... | 300 | 0 | 0 |
| Clerk ... ... ... ... ... ... ... ... | 40 | 0 | 0 |
| Clerk of the works ... ... ... ... ... ... | 140 | 0 | 0 |
| Sir James M'Adam for "coating the road;" see his evidence 1844, A. 968, and the account therein contained, including a small sum to himself for superintendence ... ... | 772 | 10 | 0 |
| Police ... ... ... ... ... ... ... ... ... | 169 | 16 | 0 |
| Gas ... ... ... ... ... ... ... ... | 65 | 0 | 0 |
| | £1,487 | 6 | 0 |

38. The general expenditure in connexion with the bridge from the 5th April, 1810, to the present time, that is to say, to the quarter ending the 5th of July, 1846, has been 120,221*l.* 15s. 10¼d. There is a further sum remaining due to Mr. W. Cubitt, under his contract; and another sum due to Mr. Walker in respect to his per centage. Probably, if the account could be closed at the date of this report, the aggregate charged and chargeable upon Westminster-bridge would not be less than 200,000*l.* from the 5th of April, 1810, to the 5th of July, 1846.

39. The sum actually expended is distributed over three periods:—1. From the 5th of April, 1810, to the 5th of April, 1838, when the commissioners began their great system of repairs and alterations in the structure and foundations of the bridge. 2. From the 5th of April, 1838, when that great system may be held to have commenced, to the 5th of April, 1844, which may be taken as the period when the attention of a committee of the House of Commons was called to the question of the expediency or inexpediency of continuing that system. 3. From the 5th of April, 1844, to the 5th of July, 1846, namely, from about the period when the said committee concurred in the expediency of continuing the system of repairs, and thereby encouraged the commissioners to proceed therein, to the period when your present committee, on a review of all the circumstances which had occured up to the 15th of July, 1846, unanimously, on that day, recommended the removal of the existing bridge, and the erection of a new bridge.

| | £. | s. | d. |
|---|---|---|---|
| The sum for the repairs under the old system, and for management, &c., was for the first period ... ... | 83,097 | 6 | 9¼ |
| The sum for the repairs uuder the new system, and for management. &c., was for the second period ... | 81,341 | 16 | 8 |
| And for the third period ... ... ... ... | 25,782 | 12 | 5 |
| | £190,221 | 15 | 10¼ |

40. In addition to this sum, in addition to the two items which remain chargeable upon the Bridge Estates for work already done, and for the per centage upon it, as noticed in paragraph 38, it must always be remembered that, in order to complete the great system of repairs commenced in 1838, two, at least, of the piers remain to be included in that system, at an expense proportionate to that of the others, and the widening of the bridge 12 feet, to make it equal in width to London-bridge, that is to say, building a bridge 12 feet broad, in union with the existing bridge, on its south side, at a cost of 40,000*l.*, the aggregate of all was stated by Mr. Walker, the professional adviser of the Bridge Commissioners, at 100,000*l.*, about the time when the works generally were discontinued on the bridge; namely, in the early summer of 1845.

41. The house will observe that your committee in their resolutions took the sum remaining to complete the repairs, and which might be saved and applied to a new bridge, if those repairs were discontinued, at no more than 70,000*l.*; they also took the amount which might be raised on the credit of the Bridge Estates, in aid of the fund for erecting a new bridge, at no more than 100,000*l.*;—in both cases preferring to understate rather than to overstate the facts on which their recommendation has been founded;—but, as they have placed on record the evidence, parole and documentary, which they received on the general subject,—the excess of charge which might remain to be incurred if a new bridge were not built, and the excess of assets, above the amount which they have been willing to take as available for a new bridge, if such new bridge be built, will be open to the judgment of the house.

42. The commissioners began the works with an amount of 51,124*l.* 19*s.* 6*d.* in the funds, and a cash balance of 4,299*l.* 0*s.* 10¼*d.*, being the accumulations of their income above their expenditure. Since that time, besides the expenditure of their current income, sales have been made, in order to provide for the repairs which they had undertaken. These sales have reduced the capital to 10,000*l.* Consols, giving an income, after deducting the property-tax of 291*l.* 5*s.* The value of their estates was estimated by their architect and surveyor, Mr. Philip Hardwicke, in 1843, at 172,521*l.*

43. The aggregate of this sum, and of the funded property, might almost have sufficed, according to some of the plans before the committee of 1844, to build a new bridge; or if not, at all events to have required but a comparatively small sum from the public Exchequer in order to complete the whole structure, as well as the approaches, of a new bridge.

44. It is right to recollect that the case of bridges in the metropolis differs widely from the case of those in the counties of the empire; not only inasmuch as all the Queen's subjects have a common interest in their resort to her capital, and a share in the fame which its aggrandizement reflects on all her dominions; but specially because, perhaps from this cause, the State did, in fact, erect the only bridge which, for centuries, existed in London; and in the last century did create, directly and indirectly, by grants from the Treasury, and by money raised by lotteries, the very fund from which the present Westminster-bridge was actually itself built 100 years ago. If, therefore, it be said, that the nation does not erect bridges in the country towns of England, or did not erect the other existing bridges in the metropolis, it may be replied, that the case of Westminster-bridge, built in a large part by annual votes from the Treasury, stands on different and now exclusive grounds; that the structure has been adopted by the nation, and that when Parliament enacted (see 9th of George II., c. 29, s. 20) (1) that it should be extra-parochial, and (2) should not be a county bridge, chargeable either to Middlesex or Surrey (see same act, sec. 21), it sanctioned its claim to be national, and to be sustained at the expense of the empire.

45. The expense, however, of a new bridge, if a new bridge shall be deemed essential, will not, as already shown, necessarily fall on the state exclusively. It was calculated in 1844 that a sum of 172,521*l.* could be raised on the credit of the Bridge Estates, irrespective of a comparatively small amount of funded property then in the hands of the commissioners; and even deducting from the number of their houses those which would be required for the completion of a most magnificent approach on the Wesminster side, if that site should be adopted, and indeed on the Surrey side, also, there will still be left, in addition to the balance of the funded property, enough to raise at least 100,000*l.*

46. In this state of things, your committee felt themselves justified in coming to the resolution which, on the 15th instant, they adopted unanimously, "That it is expedient that the present bridge be pulled down, and that a new bridge be constructed; and it is further expedient that a bill be brought into Parliament next session to transfer to Her Majesty's Commissioners of Woods, &c. the property of the Bridge Commission; just consideration being had to the claims of those officers of that commission whose services should be discontinued."

(Signed) Sir Robert Harry Inglis.
Mr. Cardwell.
Sir George Clerk.
Sir Howard Douglas.
Viscount Duncan.
Colonel Fox.
Mr. Miles Gaskell.
Lord Robert Grosvenor.
Mr. Hawes.
Sir Charles Lemon.
Mr. Stafford O'Brien.
Viscount Palmerston.
Mr. Pendarves.
Lord John Russell.
Mr. Wyse.

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## Art. .—ANALYSIS OF BOOKS.

*A History of Inventions, Discoveries, and Origins.* By John Beckmann. Fourth edition. London, Bohn, 1846.

This is a new edition of a well known work which has obtained a high reputation throughout Europe. It gives an account of the origin and successive improvements of those arts and inventions to which the present age owes its greatness, and the variety in the subjects investigated is quite as remarkable as the care of the research. Beckmann was one of the professors in the University of Gottingen, at which place he died in 1811, at the age of 72. His chief ambition was to open up the depths of knowledge to the multitude, and he wrote many popular works on agriculture, commerce, &c. with this object, which were well received, but have since been cast into the shade by the works of more original authors. The present work does not possess the same attractiveness or the same fulness of illustration as the work of Ewbank, but it is devoted to the single subject of hydraulics, whereas Beckmann's treatise is of a most heterogeneous description, as will appear from an enumeration of a few of the the subjects, which are—Italian book-keeping, pedometer, machine for noting down music, refining gold, dry gilding, gold varnish, Canary bird, archil, magnetic cures, secret poison, bellows. coaches, water-clocks, tourmaline, speaking trumpet, pine apple, sympathetic ink, diving-bell, artificial gems, scaling-wax, corn mills, verdegris, saffron, alum, &c. Some of the subjects are treated with the brevity of notes rather than with the patient investigation due to essays. The editors of the present volume. Messrs. Francis and Griffith, have added some notes that bring the information the work conveys down to the present time.

### Art. XIII.—THINGS OF THE DAY.

#### FINE ARTS.

*Mr. Blore's Report on Buckingham Palace.*—Her Majesty having for some time past been incommoded by the inadequate accommodation afforded by Buckingham Palace as a royal residence, Mr. Blore has been called in to report upon the nature and extent of the insufficiency, and the means whereby he would propose to remedy the evil. Mr. Blore has accordingly furnished a report which sets forth in the *misericordiam* fashion the hardships to which royalty has been subjected by having to reside in a palace not originally intended for the accommodation of a married Sovereign, and where the nursery has to be restricted to a few rooms not more than 15 feet high. Mr. Blore makes, we fear, but an unskilful sycophant. No doubt he wants Her Majesty to be better accommodated, and himself to be provided with a regal job; but it is a dangerous thing to adopt the strain he has chosen, as its natural effect is to create a comparison between the Queen's domestic discomforts and those of most of her subjects, and the conclusion is almost irresistable that there is no great hardship in the case. The Queen of England however, ought to have a residence fitting for the Sovereign of such a country, and if that be Mr. Blore's position, and that Buckingham Palace does not afford such a residence, no one, we believe, is disposed to deny it. But when Mr. Blore goes on to convince us that the miseries of Buckingham Palace are as great as those attributed to Seven Dials, we only laugh at the folly that seeks to create such a belief. There are plenty of families who would be happy to put up with the distresses of Buckingham Palace in spite of Mr. Blore's eloquence, and who would be untractable enough to believe that they had profited by the exchange. £150,000 is the sum required by Mr. Blore's estimate to make the palace fit for the residence of the Sovereign, but the opinion seems to be a general one tnat it would be better to erect a new palace at Kensington, and appropriate Buckingham Palace to some other purposes.

*The School of Design.*—The School of Design appears to be again composed and to be proceeding satisfactorily. The annual distribution of prizes has just been made at which Mr. H. Bellenden Ker presided, and was supported by Mr. B. Hawes, M.P., Mr. Etty, R.A., Mr. W. Hamilton, and other members of the council. The Chairman, in opening the proceedings, congratulated the meeting on the steady advance which had taken place in the School, and the great improvement manifested in the works of the Pupils. He considered this alike creditable to preceptors and students. Mr. C. H. Wilson, the Director of the School, read the report of the past year, which set forth in detail the facts asserted by the Chairman as to the satisfactory progress of the School. The paucity of the works exhibited was most satisfactorily explained by the circumstance that many of the Pupils had obtained lucrative employment in their profession, which necessarily reduced the number of their studies executed for mere practice. Mr. Etty, R.A., briefly addressed the meeting after the report had been read, and complimented the pupils generally on the improved style of their productions. Mr. Etty was especially loud in his praises of the female students. Mr. Hawes, M.P., followed in a speech highly laudatory of the School, and the mode in which it was conducted. He apologised for the absence of several of his colleagues in the Ministry, and promised a more ardent support to the institution than Government had hitherto awarded it. Previous to the commencement of the proceedings, a ruby glass vase with silver mountings, was presented to Mr. Wilson, the Director of the School, by the students in testimony of their respect and esteem.

*The Art Union Prizes.*—These prizes have now been awarded. The two chief prizes, of 300*l.* each, have been devoted to the purchase of "The Fainting of Hero," by Mr. Elmore, and "An Evening Scene" by Mr. Frank Stone; both from the Royal Academy Exhibition. Mr. Elmore's picture if we except the figure of Hero, is a carelessly executed and inefficient production. Mr. Stone's picture is as pleasing and sentimental. He is, indeed, our best sentimental painter. The prizes of 200*l.* each are, the "Interior of a Church," by David Roberts, and a landscape by Danby, called "The Dawn of Morning." The 150*l.* prizes are, Mr. Lander's "Scene from the Fair Maid of Perth;" "The Woodland Ferry," by Mr. Lee, R.A.; "Leaving Home," by Mr. T. F. Marshall, and Corbould's water-colour drawing, called "Christ Raising from Death the Daughter of Jairus."

*New Commercial Bank at Edinburgh.*—The most prominent feature of this structure, designed by Mr. Rhind, is that the tympanum of the pediment is filled with sculpture, forming a primary feature of the design. The sculpture is by Mr. A. H. Ritchie, from a model by Mr. James Wyatt. The group consists, in the centre, of a figure of Scotland, supported by Justice and Enterprise, receiving from the hands of plenty the fruits of her industry. Impersonations of Agriculture and Navigation, with emblems and accessories, fill up the right hand side of the pediment. On the left side are figures representing Merchandise and Science; while a group of three children peering into the peculiarities of a notched wheel complete the group. The figures are all well modelled and sculptured, and the draperies light and flowing; the three children are exquisite, and have rarely been equalled in modern sculpture.

*Summary.*

An eminent Spanish artist, supposed to have been sent by the Queen Maria Christina, had arrived at Bourges, to paint the portrait of Count de Montemolin.—Prince Albert has sent medals to Mr. Jesse Hartley, the dock-surveyor, and Mr. Elmes, the architect of the new courts of law, Liverpool.—The Arts have sustained a loss by the death of M. Barthèlemy Vignon, the architect, at the advanced age of 85. M. Vignon had been architect to the empress Josephine, at Malmaison, to Louis Bonaparte, when King of Holland,—and to Murat, King of Naples.—The workmen engaged in pulling down seven houses in Milk-street, Cheapside, and what was formerly called Lad-lane, but since the City improvements named Gresham-street, have found some very interesting relics of London. In digging below the foundations of the houses pulled down, they have discovered the remains of some ancient walls and vaults, and amongst the more remarkable is an archway of stone and a flight of stone steps; the archway is carefully finished off, the main wall is composed of fragments of stone, and the other portions of red brick, so strongly combined, that it is difficult, even with an iron wedge and sledge hammer, to dissever it, although it has evidently been for nearly two centuries embedded in the soil. The discovery is likely to lead to an interesting inquiry as to the buildings which stood on the locality.—The subscription for the relief of the widow and children of the late Benjamin Robert Haydon, the historical painter, now amounts to upwards of 2,000*l.* exclusive of the annuity of Lady Peel already settled on the widow.—The Emperor of Austria has conferred on Mr. Pernot, the painter, his large gold medal of Letters and the Arts.—The sculptor, Andrew Friedrich, at Strasburg, who had previously executed at his own expense a monument to Erwin, the builder of the Strasburg minster, at the native place of the latter, Steinbach, near Baden, has made to the corporation of Cologne the offer to execute a statue of John Hülz, a native of that city, who had completed the top of the Strasburg Cathedral. It is to be made of Kronthal sandstone, and placed in St. Andrew's Church, near the Cathedral.—The Scott monument, at Edinburgh, has been inaugurated during the month with the usual masonic honours. In the evening, the event was celebrated by a public dinner in the music-hall. The Lord Provost occupied the chair; Sir Adam Ferguson, and Mr. Pringle, of Whytebank, officiated as croupiers. The chairman, in proposing the "Memory of Scott," passed a high eulogium on his famed fellow-citizen. Alluding to the troubles of Sir Walter's latter days, the Lord Provost said, he persevered amidst deep discouragements and sorrows to tax his powers to the uttermost, and in his own words, "If there be a mental drudgery which lowers the spirits and lacerates the nerves, like the toil of the slave, it is that which is exacted by literary composition, when the heart is not in unison with the work in which the head is employed." The struggle was too severe for his manly frame; he conquered, but he fell; and, in dying, left behind him a renown which will only perish with the English language. The statue is by Mr. Steel; it is of Carrara marble, and represents Scott in a sitting attitude, a manuscript in his hand, and his favourite dog at his feet.—A subscription has been set on foot in the City, for the purpose of testifying the public sense entertained of the services rendered by Mr. Richard Lambert Jones in the improvement of its thoroughfares and buildings. The report of a Committee appointed to consider the best mode of appropriating the money raised, has submitted three propositions for the consideration of the subscribers—to erect a marble bust or pedestal, either in the Mansion-house, the Guildhall, or the Royal Exchange, to have a medal executed by Mr. Wyon, R,A., having on one side a portrait of Mr. Jones, and on the other a suitable inscription; one copy of such medal, in gold, to be presented to Mr. Jones, one copy, in silver, to the Lord Mayor, and each subscriber to be allowed to obtain a copy in bronze; the impression to be limited; and to found a scholarship in connection with one of the schools in the city, to be called "The Jones Scholarship,"—leaving the nomination of the school to Mr. Jones.—The *Cormoran*, now on her way from Bassora to France, contains the blocks of sculpture lately found in the ruins of Nineveh.—At Rouen, the anniversary of the Emperor Napoleon's birthday was celebrated by the erection of the crowning eagle on the summit of the column destined to commemorate the trans-shipment, at that place, of the ashes of the conqueror. The monument is, in all respects, nearly finished; and rising, as it does, on the bank of the Seine, and shewn against the background of hills which border the river, its effect is said to be imposing.—The visitors to the National Gallery numbered 456,105 in 1843; 681,845 in 1844; and 696,245 in 1845. The pictures purchased for that institution amounted to 114,804*l.* 16*s.*, for 27 of which 57,804*l.* 16*s.* was paid. By an amended return, in 1843, 604,318 persons visited the British Museum; 660,529 in 1844; and 763,831 in 1845.—From Paris, we learn that Salknecht's bronze statue of Parmentier, for the town of Montdidier, has been successfully cast, and is now exhibiting in the court-yard of the Invalides, previous to its removal to its place of destination.—According to official returns for 1846, the city of Rome is divided into 54 parishes, inhabited by 35,988 families. There are 41 bishops, 1,533 priests, 2,845 monks, and 1,472 nuns. The whole population in 1838, was 156,552; in 1845, 167,160; and in 1846, 170,199. The Jews number about 10,000.

CONSTRUCTION.

*Proposed Canal across the Isthmus of Panama.*—The *Journal of the Franklin Institute*, gives a summary of the report of M. Garella, an engineer appointed by the French Government to make a survey of the Isthmus of Panama, with the view of constructing a ship canal between the Eastern and Western oceans. From this report it appears that the whole length of the proposed canal, from its northern outlet on the Atlantic near Chagres, to its southern outlet on the Pacific near Panama, is 47½ miles; and that the distance in a straight line between the two towns is 40·68 miles. The mean level of the Pacific, at the terminus of the line, is 9½ feet above that of the Atlantic, the highest tides in the former rising 20 feet, and in the latter only 16 inches. The natural summit is ten miles from the Pacific ocean, and 460 feet above it. It is proposed to reduce the summit to a height of 135 feet above the sea, by a tunnel 3⅓ miles in length, and to overcome the remaining elevation by means of 35 lift locks, 17 upon the southern and 18 upon the northern side of the summit. The tunnel is to be through rock, in the form of a gothic arch, its height being 121 feet, and its extreme width, with a towing path, 69½ feet. By such a reduction of the summit, it is shown that an ample supply of water can be commanded, and a thorough-cut may be substituted for the tunnel, but at an increased expense. The estimates are made for a canal of dimensions suitable for ships of 1200 tons burthen. The lock-chambers are to be 210 feet long and 46½ feet wide. The width of the canal on the bottom 66 feet, at the water surface 148 feet, and the depth 22 feet. The total cost of the work, including its terminal harbours, is estimated at about 25,000,000 of dollars, and the time required to complete it ten years. A route between the two oceans, by the way of the Lake of Nicaragua, was surveyed in 1838 by an English gentleman named Bailey, employed by the government of central America. His results are given in Stephens' Incidents of Travel. The natural summit, on this line, is four miles from the Pacific, and 616 feet above it. The fall from the summit to the Lake of Nicaragua is 487 feet in 12 miles, and the whole distance from sea to sea is 125 miles. It is said that a distinguished French engineer, on surveying the Isthmus for professional purposes, has discovered gold in the sand of the sea-shore, the amount of which he calculates at five milliards of francs. The construction of a canal or railway would be paid a hundred fold by the gain of this precious metal.

*Fall of Three Houses in the Mint.*—Three Houses have fallen in the Mint. On the west side of High-street, Borough, nearly opposite St. George's church, is a place called Birdcage-alley, and at the extreme end are about six very old wooden houses, three stories high, adjacent to which is the Old Bull public-house in the Mint. Birdcage-alley runs into the most intricate part of the Mint, and was formerly the hiding-place of thieves, outlaws, &c. The whole of the fallen houses have been standing near three hundred years, and were in such a dilapidated condition that they were condemned some time ago, but notwithstanding, they have been inhabited, each with as many as eight families, chiefly consisting of poor Irish. Shortly before the accident the inmates of the house in the centre were alarmed by hearing a loud cracking noise proceed from the roof; they had not got off the threshold before the immense stack of chimneys fell in, bringing down the whole of the interior of the houses Nos. 1, 2, and 3. Fortunately, at the time when the catastrope took place the men were almost all at work, and the females with their children were sitting outside waiting for their husbands, or the loss of life must have been great. Such accidents speak very little in favour of the district surveyors under the new building act and suggest the necessity of enquiry, as there is a fault somewhere when such things can be.

*A City in the Air.*—A mirage, or *fata morgana*, was lately witnessed at Stralsund in Pomerania. On the 28th of July, at half-past 3 o'clock, a.m., it appeared on the sea-shore, about a quarter of an hour's walk from the town. On the opposite coast of the Isle of Rugen was represented the town of Stralsund, not reversed, as is usually the case in phenomena of this kind (and always so in the Straits of Messina, where the appearance is known by the name of the *fata morgana*), but exactly as the towns appears to the persons placed on that coast. The image was of a deep blue colour, and stood out on a brilliant opal-coloured ground, with extraordinary clearness and precision. What was most admired was the *facade* of the great and ancient Gothic church of St. Mary, which was reflected with such exactness that it appeared to be a daguerreotype design; so that all the lines and *contours* of the innumerable ornaments which cover this *facade*, were distinguished with ease. This magnificent mirage lasted about 20 minutes, at the end of which time the sun seemed to emerge from the Baltic.

*South Western Railway.*—Preparations for the extension of the South Western Railway to the vicinity of Waterloo Bridge are actively progressing; a number of houses in the Wandsworth-road and Vauxhall-gate are already demolished, and the occupiers of premises in the Westminster-bridge-road are now vacating them. It is intended to cross this thoroughfare by a viaduct extending in a diagonal direction from the Upper Marsh, near the Old Marsh Gate, towards Waterloo-bridge.

*Summary.*

It seems that 132,600*l.* will be required to be voted to defray the expenses incurred through the Comissariat, under the direction of the Government, for the relief of distress arising from the failure of the potato crop in Ireland; 20,000*l.* to replace the like amount advanced for the relief of the suffers by the fires which occurred at Quebec in 1845; 30,000*l.* for the relief of the sufferers by the recent conflagaration at St. John's Newfoundland; 20,000*l.* for enlarging and improving Buckingham Palace; 4,500*l.* "to make good the damage to palaces and public buildings by the storm on the 1st of August;" 30,000*l.* for harbours of refuge; and 10,000*l.* for a model prison in Ireland. There are several papers in the document in explanation of the fires at Quebec and Newfoundland, and as to the improvements required in Buckingham Palace.—The inadequate supplies of water by companies, the imperfect sewerage in towns, the open drains and ditches, and the general neglect of cleanliness, leave everywhere great quantities of organic matter to decay and putrify in the midst of crowded populations. In such circumstances, the mortality, like putrefaction, is always increased when the temperature is high; and epidemics of diarrhœa, dysentery, and cholera prevail. Many thousands of the people of England were carried off in the last quarter by these diseases, and others of the zymotic class.—On the suggestion of the French Committee of Historical Monuments, the Minister of the Interior has caused a medal to be struck, to be presented to those who have lent to his administration valuable assistance in the preservation of national monuments.—Messrs. Bowers and Murray have so far completed their contract of the Railway Dock, at Hull, that the water has been admitted, and the workmen withdrawn to their new undertaking at the East or Victoria Dock. On this occasion about 300 of those employed were entertained with good cheer and friendly feeling by Mr. Murray, at his temporary office on the works.—The design adopted for the Church of England Cemetery, at Birmingham, is that of Mr. J. Hamilton, of Gloucester. The chapel will be in the decorated style of Gothic architecture, with a tower and spire. The ornamented parts of the building will be of white stone and the plain of Wesley Castle red stone. The catacombs will be in two rows, of an elliptical form.—It is a fact worthy of notice, that the whole of the land in and about the neighbourhood of Conception Bay, in Newfoundland—very probably the whole island—is rising out of the ocean, at a rate which promises, at no very distant day, materially to affect, if not to render useless, many of the best harbours on the coast. At Port de Grave a series of observations have been made, which prove the rapid displacement of the sea level in the vicinity. Several large flat rocks, over which schooners might pass some 30 or 40 years ago with the greatest facility, are now approaching the surface, the water being scarcely navigable for a skiff.—At Portsmouth, some remarkable results have been produced by the experimental shot practice, from the *Excellent*, on the iron steamer *Ruby*. The shots which hit the *Ruby* not only penetrated the side first struck, but in some instances passed through the other side, carrying with it whole plates of iron. In action, this would risk the total loss of the vessel; for on heeling over to leeward, such a body of water must rush in that nothing could prevent her sinking, with all on board.—At Liverpool, in the short space of little more than two years and a half, five out of the seven new docks, with their two tidal basins, are more than three-fourths excavated, though little else than hard sand-stone had to be removed; the greater portion of their walls is built up: and the space for the two other docks at the extreme north, from which clay only will have to be got out, has been some time commenced upon. The sea wall in front of these docks is nearly completed, and the greater portion of it for the whole length, as far north as the site of the intended battery, is in a very forward state. Liverpool, when this wall is finished, will have a sea-wall of nearly five miles in length, broken only by the entrances to the tidal basins of its docks. At the southernmost end of this wall is the iron ship-building yard of Messrs. Vernon and Co., and the engineering works of Messrs. Bury, Curtis, and Kennedy, and north of the new docks is the boiler works of Messrs. Forrester and Co.; the whole intermediate space, whether for the extent of its buildings or its commercial activity, present a scene rarely witnessed.—Mr. Mackinnon's Public Cemeteries Bill—having for its threefold object, to prevent all interments within the precincts of ltrge towns and populous places,—to prevent dead bodies from being kept in the rooms of the poorer classes for an indefinite time, a practice inducing many pestilential disorders,—and to limit, in some measure, the exorbitant charges of undertakers and others, which the poor are unable to pay—was withdrawn, on the understanding that its principle would be adopted by the Government next session. Lord Morpeth obtained leave to bring in bills for remedying that evil consequence, to the poor, of our metropolitan improvements, which drives them from their wretched homes into abodes still more wretched,—by empowering "the Commissioners of Her Majesty's Woods to sell, on certain conditions, sites for dwellings for the poor out of the hereditary estates of the Crown;" and "out of lands vested in them under acts for the improvement of the metropolis:" and by enabling the Privy Council "to make regulations for the prevention of contagious disorders, and for the more speedy removal of nuisances."

RAILWAYS.

*New Railway Board.*—The following is the report from the select committee appointed to inquire whether, without discouraging legitimate enterprise, conditions may not be embodied in railway acts better fitted than those hitherto inserted in them to promote and secure the interests of the public:—

"1. That it is expedient that a department of the Executive Government, so constituted as to obtain public confidence, be established for the superintendence of railway business.

"2. That all proposals for the construction of new lines of railway, or for extensions or branches of existing lines, or for the amalgamation of lines already authorized with other lines or with canals, or for leasing railways or canals to railway companies, or for any other purposes relating to railways for which the sanction of Parliament is required, together with plans, sections, books of reference, and other papers required by the standing orders, should be laid before such department.

"3. That the department should test these plans, sections, &c., through its own engineers and officers, by means of local examination or otherwise, as they may think fit, and should inquire into and report to Parliament upon the particulars required by the standing orders to be specially reported upon by committees on railway bills; and that no committee on any railway bill should inquire further into such particlars, unless by the special order of the House.

"4. That this department should also inquire into the compliance with the standing orders, and how far the same, if not complied with in any particular cases, ought to be dispensed with, and should report thereupon to Parliament.

"5. That the department should receive representations from local bodies, or from individuals, for or against any proposed line, whether such representations have reference to matters of public or private interests, and should hear the parties, and should make such inquiries on the spot, or otherwise, as they may think necessary, and should report the facts, and their opinion thereupon, to Parliament.

"6. That the department should report in each case what in its judgment would be a proper tariff of fares and charges.

"7. That all bills for effecting any of the objects enumerated in the foregoing resolutions should be submitted to the department for examination and approval; and that it should be part of the duty of the department to enforce uniformity in the preparation of such bills, as far as circumstances will allow.

"8. That no bill for carrying any such proposal into effect should be introduced into Parliament without having the previous sanction of such department.

"9. That the department should be charged with a general supervision of all railways, and canals in any way connected with railways; and that for this purpose it should possess all the powers and execute all the duties now possessed and exercised by the Board of Trade, and such additional powers as may be necessary to enforce any regulations made from time to time for the accommodation and interests of the public.

"10. That the department should require from every railway company periodical returns, according to an uniform plan, approved from time to time by the department, and that it should annually lay before Parliament a report, giving the above returns, or abstracts thereof, together with such details and observations upon the state and progress of the railway system as it may deem useful."

*Continental Railways.*—The first lines undertaken on the other side of the Alps, and which are now open for traffic, are the Milan line and that of Naples. Various important projects have been recently set on foot, and, the work of improvement is proceeding with great activity. Three grand Government lines are now being deliberated upon—the Genoese line, the Turin line, and the Lago Maggiore. These will connect the metropolis of the Italian States with the sea, with Switzerland, and Northern Italy generally. For communication with Lombardy it will be necessary to extend the Milan line, above alluded to, as far as Tesin. It is also proposed to connect Savoy with Piedmont by tunnelling the base of the Alps immediately contiguous to the defile of Mont Cenis.

*Great Southern and Western.*—The bridge across the Dublin-road of the Great Southern and Western railway in Ireland is a singular work of art. The abutments to two of the opposite acute angles are 43 degrees, and consequently 47 degrees from the right angle or square. The formation of this singularly oblique arch commenced at these opposite angles, and continues on in spiral courses until they meet, when the last spiral courses will form the keystones of the whole arch.

*Accident from Engine Sparks.*—The luggage on the top of a carriage was lately ignited by the sparks from an engine in the Kilsby tunnel. Mr. Mason, town clerk of Doncaster, and Mr. Vickers, of Sheffield, who were seated in the carriage, were exposed to great personal danger. The progress of the fire was so rapid, that they were compelled to seek for safety by standing on the steps.

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*Summary.*

It appears that the royal assent has been given during the present session of Parliament, to Acts authorising the construction of no less than 3,672 miles of railway, with a capital of 20,540,938*l.*, besides power to borrow 38,688,829*l.* more, making the total amount *to be raised* little less than 130,000,000*l.* sterling.—A good deal of excitement has latterly prevailed owing to the power assumed by various railway companies of opening parcels to see whether there are smaller parcels within. The Earl of Clarendon has declared his intention of providing a remedy against the practice.—A railway Board has been recommended in a recent report of the Select Committee on Railway Acts, as a distinct department of the executive government, with engineers and other officers of its own, and "possessing all the powers, and executing all tha duties now possessed and exercised by the Board of Trade, and such additional powers as may be necessary" in the "supervision of all railways and canals in any way connected with railways." The Board is to consist of five, including the President; that officer will be salaried, as will two of the other members also; the remaining two will be members of the Government for the time being, without any additional salary for their services on the Railway Board; the President will be a removable and ministerial officer; the two non-ministerial members of the Board, will always remain a fixed centre of information amid the changes politics may work among their colleagues. Their executive staff of clerks, &c. will be principally transferred to them from the Railway Department of the Board of Trade, as they are already experienced in the labour required of them.—The new metal bridge of the Waterford and Limerick railway, close to the city of Limerick, has fallen. It is said that the bridge was but temporarily and hastily erected for the accommodation of dassengers at the Limerick cattle show, and that the efficiency of the principle on which it has been constructed has been fully tested in America.—The sixteenth meeting of the British Association will be held at Southampton, in the week commencing Thursday, 10th September. The congress is expected to be one of the fullest attended of any meeting, not only from its proximity to the metropolis, but also to France, whence a numerous attendance of members of the French Geological Society is expected. The chief excursions will be to Portsmouth, Gosport, the Isle of Wight; the docks, arsenal, and stores of the former being, as was the case at Plymouth, open to the members, on the production of their tickets. The president for the meeting is Sir R. I. Murchison, who has acted as one of the general secretaries ever since the establishment of the Association.—The London and Birmingham, Grand Junction, Liverpool and Manchester, and Manchester and Birmingham railway companies have united under the title of the London and North Western. Various improvements in the line consequent upon the amalgamation are about to be carried into effect, of which the *Railway Times* gives the following account:—"At Euston-square and Camden Town whole streets are to be demolished in order to extend the means of public accommodation. At Wolverton a little colony of men is busily at work building new and extensive houses for the reception of the immense number of locomotives belonging to the company. At the smaller stations between London and Birmingham, the welcome hand of improvement is every where to be seen. In Birmingham alterations and improvements are about to be commenced which will be worthy of the importance of the place as the central locomotive station of the country. Further on at Crewe, vast extensions are being made, and noble buildings being erected to accommodate the traffic which, in an unbroken stream, flows to that great 'railway fork'—three pronged at present, but which, ere long, will have three or four additional teeth. At the great terminus in Liverpool the alterations are being conducted on the most magnificent scale. The great tunnel, which from Liverpool is the outlet to all the world, is being ripped up for a portion of its length, in order to admit of new stations, extensive sheds, and commodious offices of all descriptions. The alterations in Liverpool are upon the most tremendous scale. They include a tunnel right under the town—a tunnel of some miles in length.—The Admiralty have finally settled the terms on which the Grand Junction Company are to be allowed to carry their line accross the Mersey at Runcorn. As conservators of the river, they require that the bridge, if built on arches, shall have waterway openings of 280 feet in the clear, and a clear headway of 100 feet under the centre of the arches; but if flat girders should be substituted for arches, 250 feet clear between the piers will be sufficient. A turret staircase is to be erected to facilitate the warping of large vessels through the bridge, and other works are specified, amongst which are the removal of the island between the Castle Rock and the Old Quay Canal, and of a large portion of the rocky shore on the Lancaster side, and part of the Castle Rock on the Cheshire side; with the erection of a curved wall or weir for 2,000 feet eastward, and, if necessary, 800 feet further.

## ENGINEERING.

*Steam Boats and Locomotives in France.*—The *Moniteur Industriel* gives an account of the number of steam vessels and locomotives in France, by which it appears, that in 1844, 238 steam-boats were employed for the following purposes:—81 to carry passengers; 2 to carry goods; 100 to carry both passengers and goods; 44 to tow; 1 to tow and carry passengers; 6 to tow and carry goods; 4 to tow, and to carry both passengers and goods. The number of engines was 382 of 12,789 horses' power, equal to 38,367 draught horses, or 26,869 boat haulers. Of these 382 engines, 254 were low pressure, 28 high pressure. The average power of the low pressure engines was 33·48 horses; and of the high pressure, 32·96 horses. If to the weight of goods carried, which was 1,081,511 tons, be added that of the passengers, which may be estimated at 230,060 tons, allowing 154 lbs. for each passenger and his luggage, the total weight carried will be 1,311,571 tons. In 1843 the total number of locomotives in France was 256, of which 127 were of foreign manufacture. In 1844 the total number was 292, of which 124 were foreign.

*Maudslay's Improvements in Propelling Machinery.*—Mr. Joseph Maudslay, of the firm of Maudslay and Field, has taken out a patent for improvements in propelling machinery, which are applicable to the screw-propeller. Mr. Maudslay employs two screws, one on each side of the rudder, as has already been done in several instances, the object of which arrangement is to prevent the water projected backwards by the screw from striking the rudder, whereby the action of the screw is attended with less shock and vibration. The screws by this arrangement are necessarily overhung, and a strong iron upright proceeds from each neck to some convenient part of the stern of the ship, on which a sliding block is placed that may be attached at pleasure to a square frame carrying the screw. To the upper part of this frame a chain is attached, and if the screw shaft be drawn back out of the boss, the square frame may be hove up by carrying the chain to a winch—the sliding block maintaining the frame in the perpendicular position. By the use of this contrivance, therefore, the screw may be shipped or uushipped with facility. This constitutes the chief part of Mr. Maudslay's improvements. He uses also a conical friction clutch, in which the conical projection is forced into the conical recess by means of three screws disposed near the periphery.

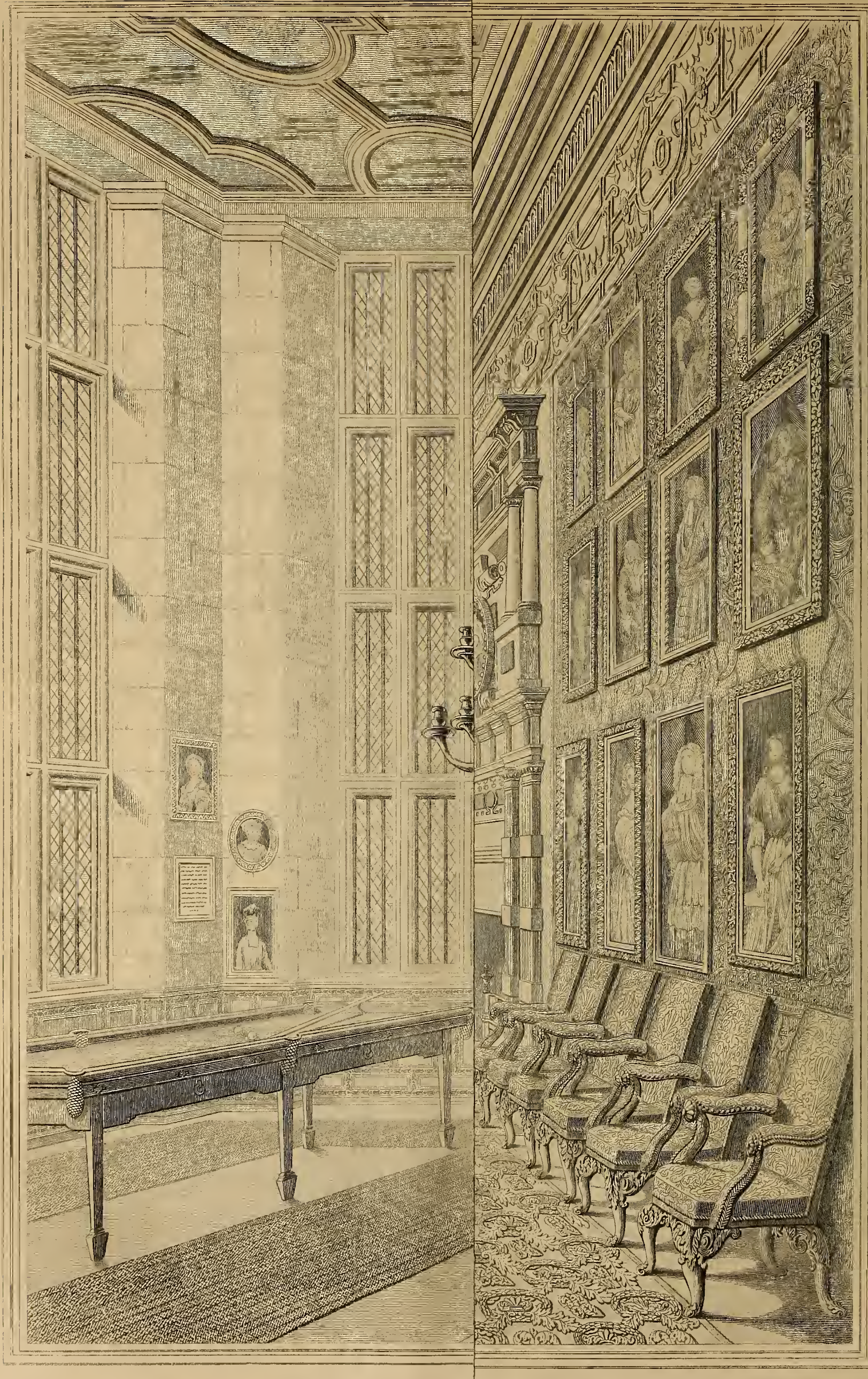
*The Steam Frigate Amphion.*—This vessel, which is provided with Mr. Smith's screw, and Count Rosen's engines, which have been constructed by Messrs. Miller, Ravenhill, and Co., has been tried, and has operated satisfactorily. With 48 revolutions of the screw in the minute a speed was realized of 6·7 knots, but the vessel was not sunk sufficiently in the water, and the screw had not a sufficient hold, so that a greater speed may be hereafter expected. The *Amphion* carries 36 guns. The engines are of 300 horses' power, and the cylinders are laid in a horizontal position. Both the engines and boilers are below the water line, and out of the reach of shot. The screw is 14 feet in diameter, and the speed has more than exceeded anticipation, as the vessel is a very heavy one, and the power but small.

*Seaward's Improvements in the Steam Engine.*—Mr. John Seaward has recently taken out a patent for improvements in the steam engine, which extend over a wide superficies. The first of these is for an improved slide, which, to obviate lateral play, is cut perpendicularly into two pieces which are forced asunder by spiral springs, but screws are added to check the force of the springs in case they should occasion too much friction. The second improvement is a method of end play in shafts by cutting the brasses perpendicularly as well as horizontal, and tightening them laterally by means of keys. The third head of improvement is an arrangement of tappets for working the slide valve; the fourth for diminishing priming by causing the steam to pass up and down several times in zig-zag passages, before entering the steam-pipe; the fifth, for unshipping the screw-propeller by enclosing it in a frame like a sugar tongs, which is hinged at the top, so as to enable the frame to move backwarks, carrying with it the screw which is thereby caused to leave the end of the shaft. The sixth and last improvement is for diminishing the friction at the end of the screw-shaft, by interposing a liquid film between the rubbing surfaces. The rubbing surfaces are of hardened steel, and in the centre of the block which recieves the thrust, a hole is made communicating with certain force-pumps which continually force a stream of oil or water through this central channel when the engine is at work, and the liquid escaping from the centre to the circumference keeps the surfaces asunder, and consequently diminishes the friction. This is an ingenious device, though not altogether novel, and we believe that it would have the desired effect.

*Clark and Varley's Atmospheric system.*—The peculiarities of this system consist in making the tube of sheet iron, wrought into the circular form. The two edges are not joined permanently together, but provided with tips about 1½ inch in height, and to one of which a piece of leather, India rubber, or some other elastic substance is attached, so that when the two lips are pressed together, as they naturally are when not kept apart by the connecting rod, a joint is formed which is perfectly air-tight, without any composition being used. At intervals along the tube are powerful springs, to exert a great pressure upon its lips.

## MISCELLANEA.

The *Teviot* West India Steamer, reports a casualty which happened to the American-built steamer Genie, plying between St. Jago de Cuba and Batabano, with mails on board. It appears she was on her passage from St. Jago when two of her boilers suddenly burst, and she soon afterwards became a total wreck. The commander, engineer, two passengers, and ten of the crew lost their lives, and eight more were seriously injured. The mails are reported as lost or destroyed.—The German papers announce that the representatives of the Zollverein States, assembled at Berlin, were greatly at variance as to the policy of making an alteration in the import duties on foreign goods, especially yarns and threads. It was concluded, therefore, that the conference would break up without recommending any change. Prussia does not appear prepared to act upon the free trade example of this country and America.—While workmen were engaged raising the black-band iron-stone, at the open cast on Bell's-holm, and after breaking up a large block about 4 or 5 feet square, they discovered near the centre of it a toad. It was small in size, and very black. As soon as it got quit of its iron-stone prison, it commenced hopping off until it got into a pool of water, and then it showed the same dexterity in swimming as those that are not accustomed to so long an imprisonment.—The Admiralty have issued an order for the distribution of the medals to the officers and men who served in the late operations on the coast of China.—The *Hindostan* nearly shared the same fate as the *Memnon* in 1843, by grounding on the night of the 27th of July, off Cape Guardafui, but she fortunately escaped without any serious damage.—A short time since another stupendous piece of ordnance was cast at Alger's Foundry, South Boston, which, when finished, will exceed Captain Stockton's celebrated "peace-maker," by 5,000lb. in weight.—Owing to the neglect of the safety valve, a boiler has burst at the Dardhill Iron works. The engineer and his daughter were scalded to death, and no less than ten men were injured by the explosion, of whom three have since died.—Some of the manufacturers at Ashton-under-Lyne have given notice of their intention to reduce wages five per cent. The operatives refuse to accede to the proposal. At Rochdale there is a turn out for higher wages.—The *Augsburg Gazette* states that a great company has been formed, which will undertake to convey travellers in all directions, and to spare them the trouble of paying the expenses of the journey *en route*, by giving them coupons on their departure, which will be received in payment throughout the journey by the hotels with which the company has made arrangements. This company is to have its seat in London. It has already made all its arrangements on the route from Ostend to Alexandria, and hopes to dispatch, a short time hence, a caravan of 300 travellers, who will proceed from Ostend to Cologne by the railroads, and will ascend the Rhine for Trieste, and thence sail for Alexandria.—It is known that carbon, or platinum, or other like difficultly fusible metal, when inclosed within air-tight vessels and subjected to a current of electricity will become luminous, but carbon, even in the purest states in which it has been hitherto obtainable when ignited, or rendered luminous in an air-tight glass vessel by means of electric currents, has been found to give out extraneous matters, which, being precipitated on the inside of the glass vessel, obscure and darken it, and platinum, when substituted for the carbon in the air-tight vessel, has yielded only a feeble light. The object, therefore, has been to discover some mode of rendering carbon absolutely pure, or at least far more pure than it has ever yet been made. This Messrs. Greener and Staite allege they have effected by taking a quantity of lamp-black or powdered charcoal, or of powdered coke, and which has been purified, by the action of electricity from sulphur and any other mixtures, and digesting the same in diluted nitro-muriatic acid. The acid is then strained off, and the carbon washed several times in water, next in some weak alkaline solution, and finally in distilled water, until no traces of impurity are preceptible. The material thus purified is next brought into a state of dryness, after which it is formed into solid prisms by means of an hydraulic press. Currents of voltaic or magnetic electricity directed to these prisms will give off a brilliant light, and the mode of connection presents no difficulty.—A swimming-school was instituted by the Eton College authorities in 1836, in order that fatal accidents to the boys on the Thames might be prevented; a regulation being made that none who could not swim should be permitted to indulge in boating. Since that time, 1,400 scholars have passed the swimming test. There are annual swimming-school games, when professorships of swimming and diving, and medals, are bestowed on the most expert. A few days ago these games were held, and every thing went off well; 217 of the present scholars are swimmers.—The iron trade of South Staffordshire is now in a more flourishing condition than it has been for some time. Orders have been pouring in from all quarters for railway iron. A contract has just been made by several of our large ironmasters for 8,000 tons of iron, for the great Menai Straite Bridge, in connection with the Chester and Holyhead Railway.—The suspension of the business of the Leeds Commercial Bank was in a quarter of an hour known in Birmingham through the electric telegraph.—The French have been carrying on some fattening experiments on ducks: those fed on rice remained lean, those fed on buttered rice became fat.



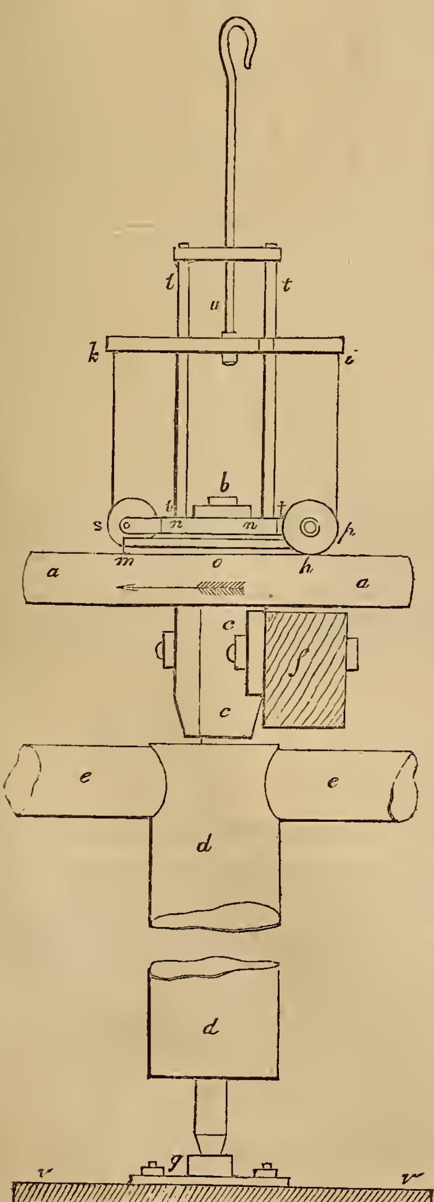
# THE ARTIZAN.

No. XXII. —New Series.—OCTOBER 1st, 1846.


## Art. I.—EXPERIMENTS ON THE CENTRIFUGAL PUMP BY MR. JAMES WHITELAW.

The followiug table contains the results of four experiments made by Mr. Whitelaw on a centrifugal pump of two feet diameter, or one foot radius, measuring from centre of upright tube to centre of the discharging orifice of one of the arms. Eight feet is the height the water is raised to.

Fig. 1.

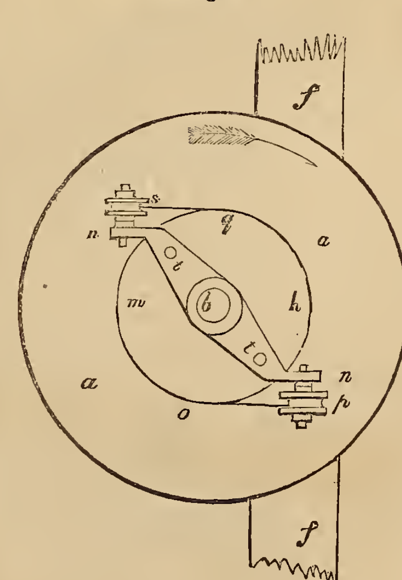



| No. | Revolutions of pump in 30 seconds. | lbs. of water raised in 30 seconds. | lbs. of water raised × 8 feet the height the water was raised to. |
|---|---|---|---|
| 1 | 159·21 | 110·40 | 883·20 |
| 2 | 192·15 | 149·50 | 1196·00 |
| 3 | 214·11 | 165·60 | 1324·80 |
| 4 | 170·19 | 112·14 | 897·12 |
| 1 | 2 | 3 | 4 |

Fig. 6 is a full-sized internal view of one of the jet-pieces of the pump the experiments were made with. While the three first experiments were performed, the pump was made to revolve in the same direction as that shown by the arrow in the fig. referred to, and the pump revolved the contrary way when the fourth experiment was made.

Fig. 1 is an elevation of part of the apparatus used for testing the pump; figs. 2 and 4 are plans of the same; and the driving pulley and some of the other parts are shown in section in fig. 5. In the different views the same letters are placed beside the same parts.

Fig. 2.

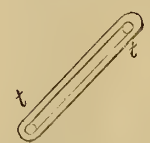



The driving pulley, *a, a,* works loose on the spindle, *b, b,* of the pump. That pulley has a long boss, as shown in fig. 5, cast on its underside, which boss works in the plumber-block, *c, c.* The upright tube of the pump is marked *d, d,* and *e, e,* represents part of the two arms of the pump. *f, f,* is a beam of wood to which the plumber-block, *c, c,* is bolted, and the bottom, *v, v,* of the box which supplies the pump with water supports the step, *g,* for the spindle at the bottom of the upright tube to work in. The part, *n, n,* is fastened to the spindle at the top of the pump, and the small pulley, *m, h,* is cast in a piece with the driving pulley. If the part *n, n,* which is fastened on

Drawn & Engraved by Henry Shaw

the spindle, *b, b,* were connected to the small pulley, *m, h,* which works loose on the same spindle by means of two strings, *m, o, p,* and *h, q, s,* it will be evident that were the pulley, *a, a,* made to revolve in the direction of the arrow by a strap or by any other means, the pump also would be kept in motion; and were it possible to determine the exact amount of strain on those strings, the power required to work the pump could be ascertained. That part of the testing apparatus which will at this time be described is for

Fig. 3.




ascertaining how much strain is on the strings, and from this the power required to keep the pump in motion. The string, *m, o, p,* in place of being tied to an end of the part, *n, n,* is passed under the small pulley, *p,* and carried upwards, and fastened to the end, *i,* of the cross-head *i, k,* and the other string, *h, q, s,* passes under the other small pulley, *s,* and is fastened to the end, *k,* of the same cross-head. The string, *m, o, p, i,* is fastened to

Fig. 4.

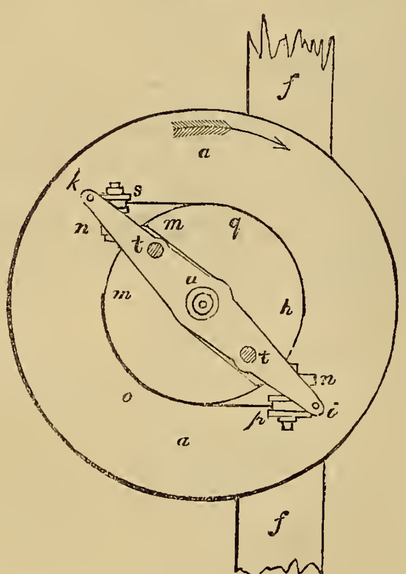
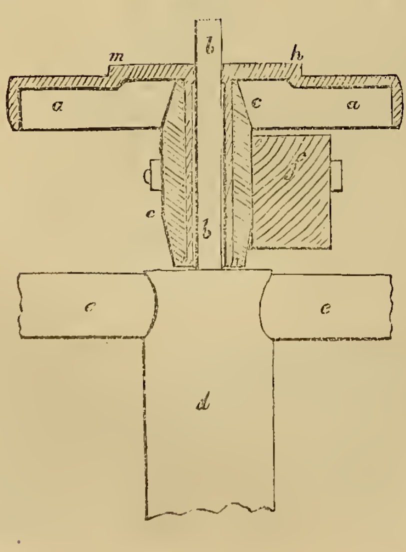
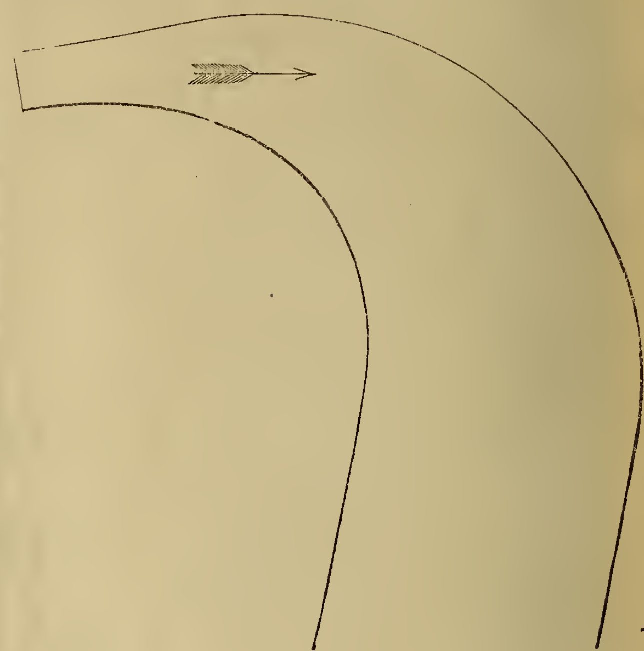



Fig. 5.




the pulley *m, h,* at the point, *m,* and the other string is fastened to that pulley at *h.* The cross-head, *i, k,* slides freely on the two guides, *t, t.* At their bottom end those guides are fastened to the part, *n, n,* and their top ends are bound together by a link, as shown in figs. 1 and 3. The cross-head, *i, k,* is supported by the rod, *u, u,* which is connected to it by a swivel joint, for the purpose of allowing the cross-head to revolve without taking the rod round with it. The strain on the cross-head, *i, k,* or, which is the same thing, the strain on the two strings, *m, o, p, i,* and *h, q, s, k,* will be known if the hook on the rod, *u, u,* be connected to a spring balance or weighing apparatus. It will now be evident that if the rod, *u, u,* were connected to the spring balance, and a uniform rotary motion in the same direction as

Fig. 6.



that of the arrow were communicated to the pulley, *a, a,* the pump would revolve at the same speed as that pulley, and the spring balance would indicate the strain on the cross-head. After the strain on the crosshead is ascertained, the powers required to work the pump may be calculated in the way as follows, viz:—

Weight in lbs. indicated by spring balance × circumference in feet of the pulley, *m, h,* × the numbers of revolutions of the pump in 30 seconds, the time an experiment lasted = the power required to work the pump.

*(To be continued.)*

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## Art. II.—THE NEW STEAM VESSELS' ACT.

Thl following are the principal provisions of this act:—

1. All steam vessels built of iron of 100 tons burden or upwards, the building of which shall have been commenced after the passing of the act, are to be divided by transverse water-tight partitions, so that the fore part of the vessel shall be separated from the engine-room by one of such partitions, and so that the after part of such vessel shall be separated from the engine-room by another of such partitions.

2. From and af.er the first day of January, 1847, no vessel, the tonnage of which shall be 100 tons or upwards, shall proceed to sea from any port whatsoever, unless it shall be provided with boats, duly supplied with all requisites for their use, and not being fewer in number, nor less in their dimensions than the number and dimensions set opposite to the limits of dimension in the following table, provided that the said limits of dimension be not considered applicable to vessels engaged in the whale fishery:—

| Tonnage of Vessel. | Number of Boats. | Long Boat, Launch, or Pinnace. Length. | Breadth. | Other Boats. Length. | Breadth. | Length. | Breadth. | Length. | Breadth. |
|---|---|---|---|---|---|---|---|---|---|
| | | Feet. | Ft. In. | Feet. | Ft. In. | Feet. | Ft. In. | Feet. | Ft. In. |
| 850 and upwards ... ... ... ... ... ... | 4 | 26 | 8 0 | 24 | 7 0 | 22 | 6 6 | 16 | 5 6 |
| 650 to 850 ... ... ... ... ... ... ... | 4 | 24 | 7 0 | 22 | 6 6 | 18 | 5 6 | 16 | 5 6 |
| 350 to 650 ... ... ... ... ... ... ... | 3 | 20 | 6 6 | 18 | 5 6 | ... | ... ... | 14 | 5 0 |
| 200 to 350 inclusive ... ... ... ... ... | 2 | 18 | 6 0 | ... | ... ... | ... | ... ... | 14 | 5 0 |
| 100 to 200 ... ... ... ... ... ... ... | 2 | ... | ... ... | 16 | 5 | and a Punt or small Boat. | | | |

and that no vessel carrying more than 10 passengers shall proceed to sea on any voyage unless, in addition to the boats hereinbefore required, it shall also be provided with a boat fitted up as a life boat, with all requisites for its use, together with two life buoys.

3. Every steamer, the building of which shall be commenced after the passing of the act, and which shall proceed to sea with passengers, shall, in addition to the boats specified in the foregoing table, and in lieu of a boat fitted up as a life boat, be provided either with such boats as are usually called paddle-box boats, or with such other boats as may be directed in lieu thereof by the Commissioners of the Admiralty.

4. That no steam vessel, of 100 tons burden or upwards, shall proceed to sea unless it shall be provided with a hose, for the purpose of extinguishing fire, capable of being connected with the engines of the vessel.

5. If any such steam vessel as aforesaid proceed to sea without being provided with such hose as aforesaid, or being an iron steam vessel without being so divided as aforesaid, or if any steam or other vessel of 100 tons burden or upwards proceed to sea without being so provided with boats as aforesaid, or if any of such boats be lost or rendered useless in the course of the voyage, through the wilful fault or negligence of the owner or master, or if in case of any of such boats being accidentally lost or injured in the course of the voyage, the master, or other person having charge of the vessel, wilfully neglect to replace or repair the same on the first convenient opportunity, then, and in every case where the owner shall appear to be in fault, he shall forfeit a sum not exceeding 100*l*., and in every case where the master, or other person having charge of the vessel, shall appear to be in fault, he shall forfeit a sum not exceeding 50*l*.

6. No officer of customs to clear out any such steam vessel as aforesaid, for any voyage to parts beyond the seas, without being provided with such hose as aforesaid, or, being an iron steam vessel, without being so divided as aforesaid, not to clear out any steam or other vessel of 100 tons burden, or upwards, for any voyage to parts beyond the seas, unless the same be provided with such boats as herein are required.

7. Every steam vessel when meeting or passing any other steam vessel shall pass, as far as may be safe, the port side of such other vessel; and every steam vessel navigating any river or narrow channel shall keep, as far as is practicable, to that side of the fairway or midchannel of such river or channel which lies on the starboard side of such vessel, due regard being had to the tide, and to the position of each vessel in such tide; and the master, or other person having the charge of any such steam vessel, and neglecting to observe these regulations, or either of them, shall for each and every instance of neglect forfeit and pay a sum not exceeding 50*l*.

8. On or before the 30th of April, and the 31st day of October, in every year, the owners of every steam vessel shall transmit to the Lords of the Committee of Privy Council for Trade the two following declarations in writing; that is to say,—

First, a declaration of the sufficiency and good condition of the hull of such steamer under the hand of a shipwright surveyor, to be approved by the Lords of the said Committee:

Second, a declaration of the sufficiency and good condition of the machinery of such steam vessel, under the hand of an engineer, to be approved in like manner by the Lords of the said Committee; such declarations bearing date of some day in the said months of April or October respectively.

And the Lords of the said Committee shall register such declarations, and shall transmit to the owners of such steam vessels respectively certificates under the hand of one of the secretaries, or assistant secretaries, of the said Committee of the registry of such declarations.

9. If any steam vessel proceed to sea with passengers, the owner whereof has not duly transmitted to the Lords of the said Committee such declarations, and received from the Lords of the said Committee such certificates of the registry of such declarations as hereinbefore is mentioned, the owner of such steam vessel shall forfeit a sum not exceeding 100*l*.

10. Whenever any steam vessel shall have sustained or caused any serious accident occasioning loss of life or property, or received any material damage affecting her sea-worthiness, either in her hull or her engine, by grounding or by collision with any other vessel, or by any other means, the master or other person having the charge of such vessel shall, as soon as conveniently may be, transmit through the Post Office, by letter addressed to the Lords of the Committee of Privy Council for Trade, and signed by such master or other person, a report of such accident or damage, and the probable occasion thereof, stating therein the name of the vessel, the port to which she belongs, and the place where she is, in order that the Lords of the said Committee may, if they think fit, investigate the matter; and should the owner or owners of any steam vessel, from her non-appearance or otherwise, have reason to apprehend that such steam vessel is wholly lost, he or they shall, as soon as conveniently may be, in like manner send notice thereof to the Lords of the said Committee; and every owner, master, or such other person as aforesaid who shall neglect to send such notice as hereby is required, within a reasonable time after any such accident shall have happened, shall for every such offence forfeit and pay a sum not exceeding 50*l*.

11. Whenever any steam vessel shall have sustained or caused any serious accident, occasioning loss of life or property, or received any material damage affecting her seaworthiness, either in her hull or her engine, by grounding or by collision with any other vessel, or by any other means, it shall be lawful for the Lords of the said Committee to appoint any proper person or persons as inspector or inspectors to inquire into and to report upon such accident; and it shall be lawful for every person so authorized at all reasonable times, upon producing his authority, if required, to go on board and inspect any such steam vessel and the machinery thereof, and every part thereof respectively, not detaining or delaying the vessel from proceeding on her voyage, and to make such inquiries as to the nature of such accident as he or they may think fit.

12. That nothing in this act shall extend to any of Her Majesty's ships of war, nor to any vessel not being a British registered vessel.

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## Art. III.—MR. LAMB'S SELF-ACTING BLOW-OFF APPARATUS AND REFRIGERATOR.

In a former number we briefly referred in terms of commendation to a blow-off apparatus for preserving boilers free from deposit, invented by Mr. Lamb, Engineer of the Peninsular and Oriental Steam Navigation Company, and which has now been applied to a large number of the marine boilers belonging to that company with satisfactory results. The principle of the invention lies in blowing off the supersalted water—which in all boilers using sea water requires to be periodically re-placed by fresher water from the sea, in order to prevent any injurious concentration of the contents of the boiler—from the surface of the water instead of from near the bottom as is the usual practice, whereby the particles of insoluble matter out of which scale is chiefly elaborated, and which are ballooned by bubbles of steam up to the surface, are caught and removed from the boiler, so that the formation of scale is, to a great extent, prevented. The hot brine in passing from the boiler warms the feed water by means of a refrigerator as it is called, interposed between the boiler and the sea, and the volume of water blown out is regulated by a float resting on the surface of the water, so that the water level can never rise too high, and the position of the feed cock regulates the quantity of water discharged. Refrigerators have already been applied to steam boilers, but they have consisted in every case with which we are acquainted, of a bundle of small tubes which were very liable to choke. Mr. Lamb's refrigerator consists of two concentric cylinders, which have but little disposition to choke, and which may be cleaned out with great facility. The structure of the apparatus will easily be apprehended by the accompanying figures.

The chief merit of this blowing off apparatus lies in blowing off from the surface of the water, which both experience and experiment shews is the right place from whence a discharging pipe should proceed. If some grains of sand, or other impalpable matter, be thrown into a Florence flask of water and heat be applied to the bottom, the particles it will be found will immediately rise to the surface, and if a small basket be hung a short distance beneath the surface, into it every particle of the matter will be instantly collected. In all boilers where deposit takes place, Mr. Lamb's apparatus will be found of material benefit, and it is quite possible with its aid to preserve them perfectly clean.

Fig. 1 shows the elevation of a self-acting blow-off apparatus, drawn to a geometrical scale, and Fig. 2, a plan thereof; *a* is a float made of copper or other metal, with a tube passing through the centre of it to admit the spindle or rod *b*, which is furnished with regulating screws and nuts, *c, c,* for the purpose of adjusting the float, *a,* to the water line; *d* is a bracket or suitable guide, which receives the rod or spindle, *b,* and serves to keep the float, *a,* steady in its action, and in a proper position; *e* is a valve with the lever, *f,* attached thereto, moving on a double joint *g,* which is cast on to the valve seat. The blow-out pipe communicates with the valve, and passing to the refrigerator, Fig. 3, and thence proceeding to the outside of the boiler, is connected to a blow-out cock, which is for the purpose of stopping the action of the blow-off apparatus, if necessary.

In fixing this apparatus inside a boiler the aperture of the valve, *e,* should be placed about twelve inches under the working water line in the boiler; and the dimensions and weights of the float, *a,* and other apparatus connected therewith, must be so arranged that it will float on the water in the boiler when it is half immersed, so that as the water line ascends in the boiler, the float, *a,* may have sufficient power to open the valve, *e,* or to shut the same when the water decends. *h* is a pipe leading from the valve, *e,* to the outer case of the refrigerator, Fig. 3, which is shown in section. Fig. 4, shows an end view of the refrigerator.

Fig. 1.

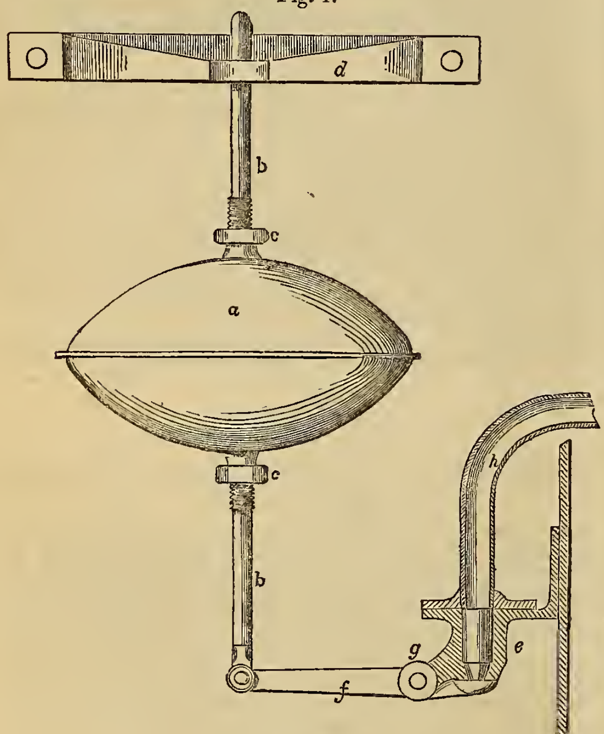



Fig. 2.

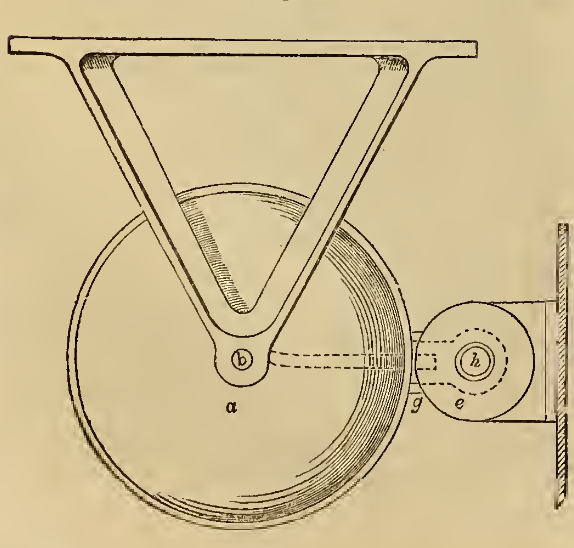
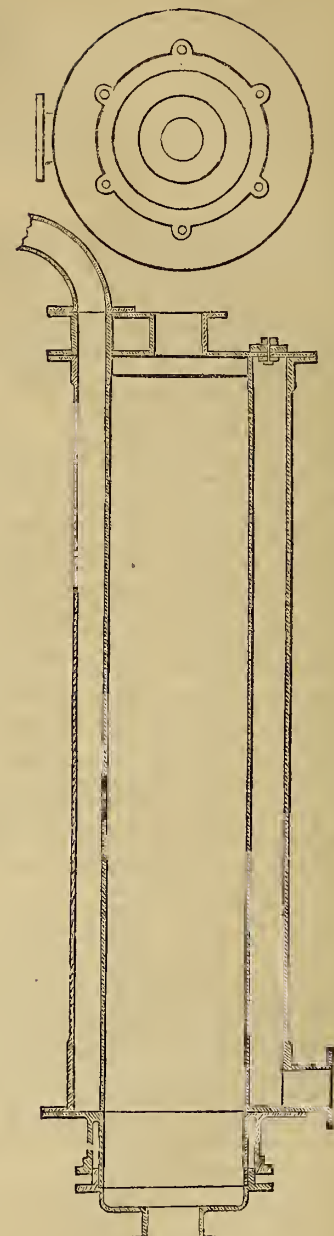



Fig. 3.



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Art. IV.—HARDWICKE HALL.

The plate given in our present number represents the Picture Gallery of this magnificent edifice, and affords a correct view of this elegant apartment. It measures 166 feet in length, by 22 in breadth, independent of two large bays measuring 21 feet by 18 feet each, and 26 feet in height. It is hung with tapestry, which is nearly obscured by the pictures which adorn the sides. The following portraits of eminent personages will be found in this vast collection of paintings.

Queen Mary, half length.
Queen Elizabeth, half length.
Lord Treasurer Burleigh, half length.
Five different Heads of Men, supposed to be Cavendishes.
Elizabeth Hardwicke, Countess of Shrewsbury, head.

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## Art. V.—MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

*Southampton, Sept.* 9.

The Committee assembled in the Town Hall, at one o'clock, and the chair was taken by the President, Sir John Herschel.

The Secretary read the Report of the Council; which congratulated the Association on the success of the application made to Her Majesty's Government for carrying into effect the recommendations respecting magnetic and meteorological observations adopted at the Cambridge Meeting. Sir R. Peel had recognized the importance of having these observations regularly made at the British observatories, and in the Colonies; and the East India Company had given directions for their continuance at Fort William, Bombay, and Madras. They are to be continued also at Toronto and St. Helena; and arrangements are in progress for establishing them at Paramatta and the Cape of Good Hope.

The Magnetic Survey of the East India Seas is in progress, and so is that of Hudson's Bay,—which will connect itself with Sir John Franklin's survey of the northern parts of America. Through the Earl of Aberdeen, application was made to foreign governments for the communication of such observations as had been made under their directions, and favourable answers had been received. Her Majesty's government had promised a favourable consideration to the application made by the Association and the Royal Society conjointly, that a premium should be offered for improvements in the construction of magnetic and meteorological instruments; and the Royal Society had given the sum of 50*l*. from the Wollaston Fund, for the construction of a self-registering instrument of this kind, at the Association's Observatory at Kew. The Committee, to which the propriety of the Association retaining the Observatory at Kew has been referred, unanimously recommended that the establishment there should be continued, as the cost was small, the situation, with reference to London, convenient, and the opportunity afforded for making various inquiries, experiments, and observations of great advantage to the Association.

The treasurer then read his Report as follows:—

*The General Treasurer's account, from the* 19*th of June* 1845 *(at Cambridge), to the* 10*th of September* 1846 *(at Southampton).*

### *RECEIPTS.*

| | £ | s. | d. | £. | s. | d. |
|---|---|---|---|---|---|---|
| Life Compositions received at the Cambridge Meeting, and since | | | | 185 | 0 | 0 |
| Annual Subscriptions ditto | | | | 161 | 0 | 0 |
| Associates' Tickets ditto | | | | 407 | 0 | 0 |
| Ladies' Tickets ditto | | | | 172 | 0 | 0 |
| Book Compositions ditto | | | | 64 | 0 | 0 |
| Dividends on Stock | | | | 919 | 0 | 0 |
| Sale of £1000 in the 3 per cent. Consols | | | | 956 | 5 | 9 |
| Cash from Cambridge Local Fund Committee | | | | 73 | 5 | 7 |
| Ditto portion of Grant returned | | | | 6 | 0 | 0 |
| Received from Sale of Publications: | | | | | | |
| Volume 1st | 2 | 2 | 5 | | | |
| „ 2nd | 2 | 12 | 0 | | | |
| „ 3rd | 5 | 3 | 0 | | | |
| „ 4th | 3 | 5 | 8 | | | |
| „ 5th | 2 | 18 | 5 | | | |
| „ 6th | 4 | 0 | 4 | | | |
| „ 7th | 3 | 15 | 0 | | | |
| „ 8th | 5 | 15 | 2 | | | |
| „ 9th | 7 | 9 | 0 | | | |
| „ 10th | 9 | 11 | 8 | | | |
| „ 11th | 7 | 3 | 6 | | | |
| „ 12th | 14 | 13 | 7 | | | |
| „ 13th | 93 | 17 | 10 | | | |
| „ 14th | 10 | 4 | 0 | | | |
| Lithograph Signature | 1 | 0 | 5 | | | |
| | | | | 173 | 12 | 0 |
| Balance carried on | | | | 125 | 3 | 1 |
| | | | | £2549 | 0 | 2 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Balance due to the General Treasurer | | | | 237 | 16 | 10 | | | |
| Ditto due from Local Treasurers | 7 | 18 | 6 | | | | | | |
| Ditto in the Bankers' hands | 104 | 14 | 3 | | | | | | |
| | | | | 112 | 13 | 9 | | | |
| | | | | | | | 125 | 3 | 1 |

### *PAYMENTS.*

| | £ | s. | d. | £. | s. | d. |
|---|---|---|---|---|---|---|
| Balance in advance on the General Account, brought on | | | | 360 | 10 | 5 |
| Sundry Disbursements by Treasurer and Local Treasurers, including the Expenses of the Meeting at Cambridge, Advertising, sundry Printing, &c. | | | | 203 | 11 | 5 |
| Printing, &c. 14th Report (13th Vol.) | | | | 774 | 2 | 4 |
| Salaries to Assistant General Secretary, Accountant, &c., 18 months, to Midsummer 1846 | | | | 525 | 0 | 0 |
| Paid to the Order of Committees on account of Grants for Scientific Purposes, viz. for | | | | | | |
| British Association Catalogue of Stars, 1844 | 211 | 15 | 0 | | | |
| Fossil Fishes of the London Clay | 100 | 0 | 0 | | | |
| Computation of the Gaussian Constants for 1839 | 500 | 0 | 0 | | | |
| Maintaining the Establishment at Kew Observatory | 146 | 16 | 7 | | | |
| Experiments on the Strength of Materials | 60 | 0 | 0 | | | |
| Researches in Asphyxia | 6 | 16 | 2 | | | |
| Examination of Fossil Shells | 10 | 0 | 0 | | | |
| Vitality of Seeds, 1844 | 2 | 15 | 10 | | | |
| Ditto 1845 | 7 | 12 | 3 | | | |
| Marine Zoology of Cornwall | 10 | 0 | 0 | | | |
| Ditto Briiain | 10 | 0 | 0 | | | |
| Exotic Anopleura, 1844 | 25 | 0 | 0 | | | |
| Expenses attending Anemometers | 11 | 7 | 6 | | | |
| Anemometers' Repairs | 2 | 3 | 6 | | | |
| Researches on Atmospheric Waves | 3 | 3 | 3 | | | |
| Captive Balloons, 1844 | 8 | 19 | 8 | | | |
| Varieties of the Human Race, 1844 | 7 | 6 | 3 | | | |
| Statistics of Sickness and Morality at York | 12 | 0 | 0 | | | |
| | | | | 685 | 16 | 0 |
| | | | | £2549 | 0 | 2 |
| By Balance in advance brought down, as per contra | | | | 125 | 3 | 1 |

*The General Treasurer in Account with the Government Grant.*

| | £ | s. | d. |
|---|---|---|---|
| Balance of Grant brought on from last Account | 634 | 2 | 0 |
| Amount paid on account of the Printing of Lalande and Lacaille Catalogues | 553 | 0 | 5 |
| Balance in Treasurers' hands | 81 | 1 | 7 |
| | £634 | 2 | 0 |

The list of members for the various sectional committees, suggested by the Committee of Recommendations, was then read and adopted.

The following were appointed members of the Committee of Recommendations:—the Officers of the Associations, Sir D. Brewster, Professor Browne, Mr. Darwin, Dr. Daubeny, Sir H. T. De la Beche, Professor Forbes, Professor Graham, Sir J. Herschel, Mr. L. Horner, Dr. Laycock, Sir C. Lemon, Mr. Lyell, Admiral Sir C. Malcolm, Mr. Mallet, the Marquis of Northamton, Professor Owen, Mr. Rennie, Mr. Robertson, Mr. G. R. Porter, Colonel Sykes, Dr. Whewell, aud Professor Willis.

On the motion of Sir Roderick Impey Murchison, the President elect, seconded by the Marquis of Northampton, it was resolved that His Royal Highness Prince Albert, having signified his intention to visit the Association and attend the opeuing Meeting, the Association do elect him their sole honorary member. The motion was carried by acclamation.

Professor Philips having read the rules of admission as modified at the Cambridge Meeting, stated that ladies' tickets were transferable to other ladies, but that the same privilege did not extend to gentlemen. The Committee then adjourned to Monday, at three o'clock; when the next place of meeting will be selected, and officers elected for the ensuing year.

#### EVENING MEETING—THURSDAY.

The business of the Sections—seven in number—commeuced in the morning. The expected visit of His Royal Highness Prince Albert attracted a lage assembly; and on his arrival, a little after eight o'clock Sir John Herschel opened the proceedings by announcing that he was about to vacate the chair, and make room for the President elect, Sir R. I. Murchison. In doing so, he congratulated the Association on the bright prospect before them of a most successful meeting at Southampton. Sir R. I. Murchison then delivered the anuual address.

The order of proceedings on the occasion of the Southampton Meeting was much the same as at former congresses of the body. On Wednesday, the General Committee assembled. On Thursday, the Sectional meetings commenced; and in the evening the General Meeting was held for the delivery of the President's opening Address, and the reception of H.R.H. Prince Albert. Friday morning was occupied with Sectional meetings; and in the evening the members mustered strong at the Victoria Rooms, to hear Professor Owen's lecture on the 'Fossil Remains of Britain.' On Saturday, there was little business tran[illegible] Sections; the day being employed by the Geological Section in [illegible] excursion round the Isle of Wight; while the Botanical Section visited the gardens of the Dean of Winchester, at Bishopstoke. The Geological Section was accompanied in its sea-trip by numbers of the other members and many of the visitors; while another party crossed the Island in carriages to look out for them by Black Gang Chine. In the evening, there was a *conversazione* at the Victoria Rooms. On Monday, the Prince-Consort visited most of the Sections; and expressed his satisfaction by the donation of 100*l.* towards the objects of the Association. There was a meeting of the General Committee at the Town Hall in the afternoon; and Mr. Lyell's lecture, at the Victoria Rooms, in the evening, on 'The Geology of Portions of the United States.' On Tuesday morning, there were Sectional meetings; and in the evening a General Meeting to witness the experiments with Professor Schenbein's explosive cotton,—and hear Mr. Grove 'On the Decomposition of Water by Heat.' On Wednesday, some of the Sections again met; in the afternoon the General Committee assembled to sanction the Grants which had passed the Committee of Recommendations; and in the evening, the concluding meeting of this congress was held, at which these grants were reported.

THURSDAY, SEPT. 10.

*Section A.—Mathematical and Physical Science.*

Sir J. F. W. Herschel, President, on taking the chair, explained the objects of the Association.

The first paper read was a Report, 'On Gauss's Magnetic Constants,' from Professor Erman.—The author, after pointing out, by several examples, the uselessness of accumulating, beyond certain bounds, mere observations, without subjecting them to scientific reduction, and the importance now attached on all hands to such reductions—as exemplified in the case of the reduction of all the Greenwich Observations, lately executed by the Admiralty, at the solicitation of the British Association,—a work which M. Bessel welcomed in the last moments of his life as the beginning of a new period in astronomy;—and, after instancing the fact that the Association had been compelled to discontinue many valuable and systematized courses of meteorological observations, in consequence of the stores of unreduced observations outstripping their power to have them reduced, stated, that the determination of the Guassian magnetic constants had appeared to them, at a meeting at Cambridge, last year, of such importance, that a sum of 50*l.* was entrusted to him, for the purpose of reducing certain observations made by him on terrestrial magnetism, during the year 1828, at several stations round the earth; and applying them to the purpose of determining those constants for that year. The present report was a statement of the results already obtained from this arrangement. The observations to be reduced had been made by M. Erman, from the year 1828 to 1830, at 650 nearly equidistant stations, along a line encircling the globe between the latitudes 62° N. and 60° S.:—at each station the dip, the horizontal direction, and the intensity had been observed. The labour of reducing these had not only far exceeded that which he (M. Erman) could afford to bestow on it, but even the leisure of an industrious and intelligent young mathematical friend, M. Petersen, was found to be quite inadequate, also when the Association, recognizing the importance of the work, placed at his disposal 50*l.*, in order to enable M. Petersen to prosecute the task; and the report now detailed the extent to which he had gone in his labours. The President then said, that, as the rest of the Report was mathematical statement and arithmetical applications of formulæ, he could not hope to make it intelligible to the Section by reading. Of the 650 stations of M. Erman, the observations of 283 had been reduced. The Section might judge of the amount of labour involved in these reductions when he informed them that the tables which he now exhibited embraced 180,000 calculations, each of which required the table of logarithms to be five times consulted;—this was a degree of labour which the same sum of money would utterly fail of purchasing in this country.

'On the Bands formed by the Partial Interception of the Prismatic Spectrum,' by Prof. Powell.—The Professor gave a brief history of the announcement of what was called a new polarity of light, by Sir D. Brewster, at the Liverpool and Newcastle Meetings; of the first paper, communicated by the Astronomer-Royal to the Royal Society, to show that the fact on which Sir David Brewster founded this announcement was a result of the ordinary theory of undulations, without requiring any aid of the hypothesis of a new polarity of light.

'On the Constitution and Forces of the Molecules of Matter,' by Dr. Laming.—This was an elaborate theory of the molecular constitution of matter; applied in forty-two distinct propositions to the explanation of gravitation, temperature and specific heats of gases, cohesion, affinities, latent heat, volume, disturbances of electrical equilibrium, and other electrical phenomena, with electro-motion and electro-chemical decomposition. One remarkable consequence of this theory is, that gravitation depends on the electrical atoms alone; and that hence a positively electrified body must be heavier, and a negatively electrified body lighter, than the same body with its electricity in the ordinary undisturbed state. This the author proposed to prove experimentally to the Section by an experiment to which he was conducted by the theory, as soon as he could procure a cylinder electrical machine with an insulated rubber. The President proposed that discussion on the communication should be suspended until Mr. Laming had exhibited this experiment.

'On Magnetic Causation, and Intrinsic Forces,' by Mr. G. Towler.—The Secretary read an abstract of this very voluminous communication,—but it would be impossible to make his views intelligible in any reasonable space.

FRIDAY.

Prof. Challis reported provisionally his regret that a press of business had prevented him from this year presenting the Report on the advance of Astronomy which he had been requested to draw up; and expressed strong hopes of having it ready to present to the succeeding meeting.—Dr. Whewell could testify that his friend Prof. Challis had been this year invaded by such a list of barbarous comets as to render the completion of the report impossible.

'Report on Recent Researches in Hydrodynamics,' by G. B. Stokes.—This report was divided into the following heads:—1. General theories connected with the ordinary equations of fluid motion. 2. Theory of waves, including tides. 3. The discharge of gases through small orifices. 4. Theory of sound. 5. Simultaneous oscillations of fluids and solids. 6. Formation of the equations of motion, when the pressure is not supposed equal in all directions. The first head referred to investigations of a rather abstract nature. Under the second, the researches of Mr. Green, Prof. Kelland, and Mr. Airy, on the subject of waves, were particularly alluded to, and the accurate agreement of theory with the experiments of Scott Russell pointed out. The important investigations of Mr. Airy on the theory of the tides, were also mentioned. Under the next head were mentioned some experiments of MM. Barre de Saint-Venant and Wantzel, by which an empirical formula was obtained for the velocity of discharge of air through a small orifice, when the discharge is produced by a considerable difference of pressure. The common formula does not apply to extreme cases. A memoir, by Mr. Green, on the reflexion and refraction of sound was then alluded to,—a memoir which is remarkable from its bearing on the physical theory of light.. The investigations mentioned under the fifth head related principally to the motion of pendulums in resisting media. Mr. Green has solved the problem in the case of an oscillating ellipsoid. The last head contained a notice of the theories of MM. Navier, Poisson, and others, on the irregularity of pressure in different directions about the same point. This theory may be considered to be that of the internal friction of fluids.

'Notice of a New Property of Light exhibited in the Action of Chrysammate of Potass upon Common and Polarized Light,' by Sir D. Brewster.

Prof. Powell said that the young gentleman who sat near him was the discoverer of the chrysammic acid, and would perhaps be kind enough to describe its mode of production. Mr. Schunk, of Rochdale, said that he had discovered the acid, which was part of the composition of the salt of which Sir D. Brewster's paper treated. It was formed by the action of boiling nitric acid upon aloes, and was one of the last products of that action. The chrysammate of potass was a beautiful and curious salt; and, although so plastic as to be readily moulded into thin plates, was yet so sparingly soluble as to require above 1,500 times its weight of water to dissolve it.

'On Elliptic Polarization,' by Mr. Dale.

'On certain Cases of Elliptic Polarization of Light by Reflexion,' by Prof. Powell.

'On some Results of the Magnetic Observations made at General Sir T. M. Brisbane's Observatory, Makerstoun,' by J. A. Broun.—The variations of force with reference to the moon's hour angle were found by Mr. Brown as follows:—The principle maximum occurs about two hours after the moon's passage of the inferior meridian; a secondary minimum about four hours before the passage of the superior meridian; a secondary maximum about one hour after the superior passage; and the principal minimum about six hours and a half after that passage. Curves were exhibited illustrating these results, and also the diurnal motion of a magnetic needle freely suspended in the direction of the magnetic force. From the latter some curious results have been deduced. It will be enough to mention at present that in the mean for the year, the motion from 6 a.m. till 6 p.m. is very trifling; between midnight and 6 a.m. the needle is almost stationary, nearly the whole motion occurring between 6 a.m. noon, and 6 p.m. The end of the needle describes an ellipse whose major axis is at right angles to the magnetic meridian; but the direction of this axis varies throughout the year.

Mr. Hopkins, 'On the Relations of the Semi-Diurnal Movements of the Barometer to Land and Sea Breezes.'—Mr. Hopkins exhibited diagrams, drawn up from Col. Sabine's paper, 'On the Meteorology of Bombay,' of the diurnal temperature curve, total pressure curve, and gaseous pressure curve; with a diagram representing the swelling and sinking of the land and sea breezes; and endeavoured to show that these were inconsistent with the explanation given by Col. Sabine, but harmonized with alternations of pressure caused by the alternate extrication of heat and absorption of it during the alternate evaporations and deposition of water, in the state of clouds and dew. He regretted that Col. Sabine had not given tables of the wet and dry bulb thermometers at the several hours of the day.

Capt. SHORTREDE asked Mr. Hopkins several questions; and, from his own observations in India, extending over many years, must dissent from Mr. Hoskins, as to the manner in which he supposed clouds to form and disperse. The effects he ascribed were disproved by the fact, that several miles inland, where there were no land and sea breezes, the clouds were formed and dispersed in precisely the same manner.

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*Section B.—Chemistry and Mineralogy.*
*President.*—Mr. FARADAY.

'On the Presence of Atmospheric Air and Uncombined Chlorine and Carbonic Acid found in the Water of some of the wells of the suburbs of Southampton, and their Action on Lead,' by H. OSBORN.—The principal object of this paper was to caution persons residing in the neighbourhood of Southampton against the use of leaden pipes for conveying water, and to induce them to avoid the use of lead in any form for that purpose without having the water previously examined in order to ascertain whether it possessed the property of acting upon the metal, and holding it in solution. The author brought forward several instances of the serious consequences which had resulted from the use of water impregnated with lead, and pointed out the different solvent principles found in the water; one of which was uncombined chlorine, discovered in a spring in the New Forest. The water possessed the property of bleaching Brazil paper, and reddening litmus paper by evaporation.

Dr. DAUBENY made some remarks pointing out the importance of the inquiry of Mr. Osborn, and the necessity of paying attention to the condition of the water supplied to towns through leaden pipes, or received in leaden cisterns.—Mr. PEARSALL stated that he found the presence of lead may be constantly removed from the water by the action of carbon, and that lead may be always separated by well agitating the water in contact with the air, and mixing up the sedimentary deposits. The subject excited considerable attention, and many gentlemen joined in the conversation,—all of them adducing additional evidence of the importance of investigating the condition of water supplied to large towns.

'On the use of stating, with the results of Analysis, the nature of the Methods employed,' by W. WEST.—The author of this communication pointed out the necessity which existed for knowing, not merely the results to which chemists might arrive, but the processes by which these results were obtained. It was shown that many of the discrepancies found to exist in analytical results would thus be satisfactorily explained, and all doubt as to the correctness of an analysis removed.

'Report on the Actinograph,' by R. HUNT.—A description of this instrument, which is employed for the purpose of registering the amount of chemical influence existing, at all periods of the day or year, in the solar rays, was given. It was found difficult to use this instrument in London—it was therefore proposed to transfer it to the Observatory of the Association at Kew.

'Notices of the progress of Experiments on the Influence of Light on the Growth of Plants,' by R. HUNT.—The experiments described in former communications to the Association had all been confirmed by the results obtained during the past year. It had been found that seeds would not germinate if all the chemical rays were prevented from acting on them—and that the influence of the actinic or chemical rays was such that seeds germinated at a depth below the soil, under the influence of concentrated actinic force acting on the surface, at which they would not have germinated under the natural conditions. The leaves being developed, the action of the luminous rays then became necessary to effect the decomposition of carbonic acid and the deposition of woody fibre within the plant. Under the joint influence of light and actinism the plant arrived at maturity, and then the calorific, or heat-producing, rays were brought more fully into action to produce the ripening of fruit and the developement of seed.

The paper gave rise to a long discussion, in which Dr. Daubeny, Prof. Grove, Mr. Prideaux, of Plymouth, and several other gentlemen joined.

FRIDAY.

Prof. DAUBENY communicated a paper 'On the Rationale of certain Practices employed in Agriculture,' specifying amongst the rest the use of quick-lime and of gypsum as fertilizers to the land. The former of these substances he supposes to act in part, by rendering those inorganic substances which are present in the soil more soluble, or,—in accordance with the views laid down by the author in a memoir which he has published in the Philosophical Transactions of last year,—by converting the *dormant* constituents of the soil into active ones, or into a state in which they become immediately available. He appealed to the authority of Prof. Fuchs, confirmed by that of Mr. Prideaux, of Plymouth, as showing that the alkali may be extracted from granite readily by water, after the rock in a pounded form has been heated, together with quicklime; and he stated that a soil exhausted by long-continued cropping was found by himself to yield to water twice as much alkali, after having been mixed with quicklime, as it had done before. Hence the frequent application of lime tends to produce exhaustion in the land;—not only because it supplies in itself no fresh alkali, but likewise because, by rendering that which the soil contains more soluble, it causes it to be washed away more readily by atmospheric water. Ploughing, and other mechanical methods of pulverizing the soil, appear to act in the same way; and so, also, may we suppose to do the sprinkling of the soil with sulphuric acid, as is practised in some parts of the Continent. The author then alluded to the various modes of explaining the advantage attributed to gypsum, which certain leading agricultural chemists had proposed: one ascribing its virtues to the direct influence of the salt; another to the indirect good resulting from it, owing to its property of fixing ammonia; a third, regarding its acid constituent as of the principal utility, and a fourth, its base. Dr. Daubeny gave reasons for rejecting the third and fourth of these hypotheses; but considered that the use of gypsum may be in part attributable to the first, and in part to the second, of the causes pointed out.

A long discussion followed;—several agricultural gentlemen remarking on the effects of carbonate of lime on wheat crops, and on the resulting weakness of the straw, owing to a deficiency of the silicate of potash necessary for the formation of the supporting epidermis of the grass. Some specimens of the disease in turnips, commonly called fingers-and-toes, were exhibited; and it was stated that the superphosphate of lime was a remedy for that disease.—The BISHOP OF NORWICH, however, remarked that the cause assigned for this disease was not that to which he believed it must be attributed. The flow of the sap was checked by the action of an insect, and then an abnormal condition developed. This year, in many parts of the country, this and similar diseases were very prevalent; and the rev. prelate was disposed to regard the existence so abundantly of this insect as in some way connected with the electrical condition of the atmosphere during the exceedingly hot weather which has prevailed,—producing with extreme rapidity the decomposition of animal and vegetable matter. — Dr. FARADAY made a few remarks on our general ignorance of the chemistry of vegetable life, and on the importance of such meetings as the present, where the chemist and the agriculturist might meet and compare results. Since the days of Davy the science of agriculture has considerably advanced; but all that he heard convinced him of the fact, that we were only standing on the very threshold of an inquiry which would eventually, now that attention was so generally turned to the subject, advance our knowledge in an extraordinary degree.

'On the Decomposition of Water into its constituent Gases by Heat,' by W. R. GROVE.—Prof. Grove, in the first place, called attention to the fact, proved by Cavendish and the French philosophers, that oxygen and hydrogen being exposed to a high temperature, or the electric spark—immediately combined to form water. He then annouuced his discovery that all the processes by which water may be formed are capable of decomposing water.

Dr. L. PLAYFAIR remarked that the facts which Mr. Grove had announced might possibly be regarded as due to a catalytic action of the platina, such as had been observed by Dr. Faraday, and such as was evidenced in the action of oxide of copper on the hypochlorites. Many bodies at high temperatures exhibited a great affinity for oxygen, which they did not possess at lower temperatures:—as, for instance, silver, gold, and even platina itself, which metals absorbed oxygen when intensely heated, and gave it out again on cooling. If the experiments had been tried in tubes of quartz or silica, they would not have been open to the objection which the use of so peculiar a metal as platina appeared to involve.—Dr. LEESON made some remarks, which went to show that in all probability the bursting of steam boilers might be explained by the discovery of Prof. Grove.—Mr. HUNT explained some experiments of Woolfe on the boilers of some Cornish steam-engines, which appeared to prove the conversion of steam into gas under the influence of the heat to which the water and steam were exposed in the experiments.—Prof. FARADAY thought Mr. Grove's discovery would not explain the bursting of steam-boilers, which might be easily done by Prof. Boutigny's experiments on the spheroidal condition of fluids. He did not agree with Prof. Grove that the repulsion of the steam was insufficient to explain the spheroidal state. He would rather desire, in the present stage of the inquiry, to discuss the philosophy of the question than the applications of Mr. Groves's discovery. Was it a decomposition of water by the agency of heat, or was it the action of certain substances when heated? It appeared to him that the investigation was a great step onwards and towards a knowledge of the corpuscular action of bodies, and he did not doubt that some remarkable developements as to the influence of caloric in overcoming the force of aggregation would ensue.

'On the Fairy-rings of Pastures,' by Prof. J. T. WRAY.—A description of these patches, with which most persons are familiar, was given; and it was stated that the grass of which such rings are formed, is always the first to vegetate in the spring, and keeps the lead of the ordinary grass of the pastures till the period of cutting.

'On the Expansion of Salts,' by Dr. L. PLAYFAIR and Mr. JOULE.—This communication was a continuation of the researches of Messrs. Playfair and Joule on the specific gravities and atomic volumes of bodies. The expansion of salts was now the subject engaging their attention; and they had been induced to modify the forms of their apparatus to meet the exigencies of this investigation. The paper was little more than a description of the apparatus employed in this elaborate inquiry.

'Notices of Experiments in Thermo-Electricity,' by Dr. J. Reade.—Some experiments were shown, by which a brass bar covered with paper, placed in the focus of a reflecting sheet of copper bent into a semi-circular form, and at a short distance from a spirit lamp, was made to revolve. This Dr. Reade thought to be due to the influence of thermo-electricity.

Dr. Faraday, however, showed that a strong current of air circulated around the copper and the lamp, sufficient to take the smoke of ignited paper rapidly around; and thus, in all probability, the rotation must be referred to mere currents of air, and not to any thermo-electrical action.

Mr. E. J. Knowles made some remarks on a singular appearance which he had witnessed in the flame of a common mould candle.

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THURSDAY.

*Section C.—Geology.*

*President*—Mr. L. Horner.

'On the Artesian Well on the Southampton Common,' by R. Keele, Esq.—The town of Southhampton has hitherto depended for a supply of fresh water to private wells, which are attached to almost every house. They are sunk through a bed of gravel, and vary in depth from 10 to 20 or 25 feet—at which depth the London clay is reached. An uncertain quantity has also been obtained from the public water-works, supplied by land springs. These sources being insufficient for a growing town, with 30,000 inhabitants, other modes of supply have long been contemplated. The river Test was considered too distant; and the commissioners could not accede to the terms proposed by the proprietor of the most convenient part of the river Itchen. In November, 1835, Mr. Clarke, of London, made an experimental boring on the Southampton Common, through 80 feet of alluvial strata, 300 feet of London clay, and about 100 feet of plastic clay; and afterwards the boring was extended 50 feet into the chalk. The supply was ample; and an Act of Parliament was obtained for providing the means necessary to construct a well which should supply 40,000 cubic feet of water daily. Mr. Clarke estimated the expense at 7,000*l*. In 1837, a contract was made with Mr. Collyer, who proposed to sink an iron cylinder, having a diameter of 13 feet, to the depth of 160 feet, and from that point to bore to the further depth of 409 feet, commencing with a bore of 30 inches, and gradually diminishing to one of 20. The estimate amounted to 9,930*l*. The cylinder was found inefficient; and a brick shaft, of 14 feet diameter, was continued to the intended depth of 160 feet. Two pumps were employed to raise the water, which amounted to 4,000 cubic feet per diem. Here, instead of commencing the boring, the brick shaft was carried on, by advice of the consulting engineer. At the depth of 164 feet, the diameter of the shaft was reduced to 11 feet 6 inches. At this period, the candles could scarcely be kept lighted; and an air-tube of zinc, with a pair of bellows worked by the steam-engine, was attached, for the purpose of ventilation. Masses of limestone, five or six tons in weight, had frequently to be raised. There was a considerable escape of gas from the sides and bottom of the well, which, together with the vapour that filled the shaft and the impure air caused by so many men at work, occasioned some alarm. At the depth of 214 feet, the shaft was reduced to 10 feet in diameter; and at the depth of 270 feet, to 8 feet 6 inches. The work was then suspended till more powerful pumps could be obtained. On emptying the shaft, and deepening it 23 feet, the influx of water became so great that iron cylinders, 7 feet in diameter, were again resorted to, instead of brickwork. At $322\frac{1}{2}$ feet the brick shaft was resumed;—the quantity of water raised by the engine amounted to 30,240 gallons in twenty-four hours. At 310 feet from the top of the well, the plastic clay was reached, and the brick shaft continued through it to the chalk. Little or no sand or water was found in the plastic clay. The work was continued, day and night, till December 4, 1841, when the shaft was 520 feet deep;—about three gallons of water flowed into it per minute, its temperature at the bottom ranging from 61° to 62° Fah. The atmosphere of the well at 50 feet was 54°; at 160 feet, 60°; at 543, 65°. The temperature of water at the surface was 44°. In March, 1842, the shaft measured 562 feet; and the pumping having been suspended for a week. the water rose 400 feet, amounting in quantity to 21,578 cubic feet. This supply being insufficient, the contractors commenced boring with a $7\frac{1}{2}$-inch augur, attached to a rod, conducted to the bottom of the shaft by an iron tube, fixed in the centre of the well. The total depth of the shaft and boring amounts to 1,260 feet; and at the time the boring was suspended the water rose to within 40 seet of the surface. In 1845, during upwards of four months' daily pumping, the delivery of water was at the rate of upwards of 1,500,000 gallons per month; and afterwards, in eight days, the quantity raised exceeded 725,000 gallons. When the pumping was discontinued in November, 1845, the water rose, as before, to within 40 feet of the surface.

'On the Origin of the Coal of Silesia,' by Professor Goeppert, of Breslau.—This paper was an abstract of an essay which received the prize offered by the Society of Sciences of Holland, at Haerlem, in 1844. Prof. Goeppert remarks, that hitherto few well-preserved plants had been obtained from the coal itself, but its composition had been inferred from the plants which lie in the associated shales. In the coal-fields of Upper and Lower Silesia, which yield 4,000,000 tons a-year, he had met with extensive layers, in which the plants were so well preserved, that he could distinguished coal formed from Sigillariæ from that formed by Araucariæ or Leipdodendra. In most instances the bark alone was preserved—the specimens being flattened; but the Araucariæ, being much harder than the rest, often retained their woody tissue and medullary rays. The species, 80 in number, were found to be differently grouped in the various coal strata, and also under different conditions; and this, with the delicate preservation of the ferns, the multitude of upright stems, of which 200 have already been observed, and the uniform thickness of the strata over a space of many miles, are considered by the author a proof of tranquil deposition on the present localities. The Silesian coal strata are from 30 to 60 feet thick; a larger portion of which M. Goeppert supposes to have accumulated after the manner of *peat*—during the lapse of time. He has ascertained that, by keeping vegetables in boiling water for three months or a year, they are converted into brown coal *(lignite)*, and, by the addition of a small quantity of sulphate of iron, a salt which occurs commonly in coal, acquire, at last, a totally black, coal-like condition.—Sir R. I. Murchison expressed his readiness to receive this explanation for the origin of many extensive coal strata. There were other large coal-fields to which the explanation would not apply at all—the materials having certainly been drifted to a distance by currents of water.—Mr. J. Phillips remarked, that although even fragments of coal-plants were uncommon in the coal of England, yet, with the aid of the microscope, *coniferious tissue* might be detected in much of the fibrous coal, which differed only in being less bituminous than the rest. In the ashes of coal, siliceous casts of vegetable tissue were always to be found; and Mr. Bowerbank had detected traces of structure on the fractured surfaces of ordinary solid coal.

'On the Northwich Salt-Field,' by G. W. Ormerod.

FRIDAY.

'On the Arrangement and Nomenclature of some of the Subcretaceous Strata,' by Dr. Fitton.—This paper contained a summary of the latest inquiries upon the subject, and a tabulated arrangement of the species in a new collection of fossils, made by the author, in the cliff sections near Atherfield, from the gault down to the weald clay. The specimens had been named by Mr. Morris, from his own observations and comparison with the series at the Geological Society, catalogued by Mr. Forbes.

'On the Occurrence of Cypris in a part of the Tertiary Freshwater Strata of the Isle of Wight,' by J. Prestwich, Jun.—A species belonging to this genus of small freshwater crustaceans abounds in the tertiary lacustrine formation of Auvergne, and others occur in the upper and lower beds of the Paris basin, and are (*C. punctata*) in the plastic clay. In the English tertiary they are extremely rare; in the London basin only a marine Fauna (Cytherina) occurs, and Mr. Lyell mentions the rare occurrence of an undescribed species in the freshwater strata of Hordwell Cliff. At Hempstead Cliff, about one mile and a half east of Yarmouth, Mr. Prestwich found a new species of Cypris in considerable abundance, the cliff being composed chiefly of beds of clay and marl, containing freshwater shells, impressions of plants and seed vessels. Amongst the shells are new species of Patamides and Melania.

'On Certain Deviations of the Plum-line from its Mean Direction, as observed in the neighbourhood of Shanklin Down, in the Isle of Wight, during the progress of the Ordinance Survey,' by Mr. W. Hopkins.—The difference of latitude between Geenwich and the station of the Ordnance surveyors at Dunnose, on the *north* side of Shanklin Down, as determined by triangulation, was *greater* by 2·22 seconds, than as determined by zenith sector observations. When, however, a new station was chosen on the *south* side of Shanklin Down, the difference of latitude, as determined by triangulation, was *less* by 3·09 seconds than it appeared to be when determined by the zenith sector. These discrepancies would be accounted for, if the mass intervening between the stations at Shanklin Down were sufficient to produce, by its attraction on the plumb-line, the observed deviations. The requisite calculations for proving the adequacy of this cause had not been made; the tendancy, however, would necessarily be to produce effects of the same nature as those observed; and the author thought it probable that the intensity of the attraction of the hill would be found sufficient to account for the phenomena.

Capt. Ibbetson and Prof. Forbes exhibited models and sections of various parts of the Isle of Wight, and pointed out the localities and geological features most interesting to visitors.

Capt. Ibbetson exhibited sections of the Great Oolite, Fuller's Earth, and Inferior Oolite, as seen in the Great Western Railway cuttings and tunnels near Sapperton, in Gloucestershire.

'On the Age of the Silurian Limestone of Hay Head, near Barr Beacon, in Staffordshire,' by J. Buckman.—The limestone rocks and shale of Hay Head, celebrated as the original locality from whence was obtained the Barr Trilobite (*Bumastus barriensis*), were referred by Sir R. I. Murchison to the Wenlock series of the upper Silurian system. This opinion having been doubted by Burmeister, who places the Barr Trilobite in the lower Silurian division, Mr. Buckman commenced an examination of all the fossils associated with that species at Hay Head. Of the fifty-six species there obtained, fifty-three belong exclusively to the upper Silurian beds, and have also been found in the Wenlock series of Dudley; whilst *only one*, and that a doubtful species, can be referred to a lower bed. The author hence concludes that Sir R. I. Murchison's sections and notes upon this locality are correct; though he considers it probable that a seam of the coal measures occupies a small tract in the valley between Hay Head and the town of Walsall.

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*Section D.—Zoology and Botany.*

*President*—Sir J. Richardson.

The President, in opening the meeting, stated that he had great pleasure in informing the members that Haslar Hospital, the Museum, the Clarence Victualling Yard at Gosport, and the Dockyard at Portsmouth, could be visited by members on presenting their tickets.

Mr. J. Hogg commenced the business by reading some additions to his 'Synopsis of the Classification of the Genera of British Birds.'—This paper, which was purely of a technical character, gave the author's arrangement of the entire number of the *Genera* of *British* Birds,—and so it completed the former portion of that classification which he had communicated, two years ago, at a meeting of the Association at York.

Dr. Lankester read over a list of the names of periodical birds, and the dates of their appearance and disappearance, at Llanrwst, in North Wales, by John Blackwall, Esq.

Mr. A. Strickland thought such lists as these were useless, as they only afforded information with regard to individual facts. So constant were many of the phenomena exhibited by animals, that the day, and almost the hour, were known. Starlings, he knew, were hatched every year on the same day. Hawks were always taken from their nests on a particular day for hawking, or they could not be used.

Mr. Wollaston read a notice from Mr. William King, of some new species of animals, found on the coast of Northumberland.

Prof. E. Forbes pointed out the importance of such researches as these in relation to geology. The animals found by Mr. King were amongst those which were also found in the pleistocene beds of the tertiary strata. There was one remarkable feature connected with these researches of Mr. King, and that was the confirmation it afforded of the truthfulness of the observations of Capt. Laskey,—who had, many years ago, announced the discovery of some of the same animals.

Prof. Owen read a paper, 'On the Homologies of the Bones collectively called "temporal" in Human Anatomy.'

'On the Pulmograde Medusæ of the British Seas,' by Prof. E. Forbes.

FRIDAY.

'On the application of the method, discovered by the late Dr. Thibert, of modelling and colouring after nature all kinds of fishes,' by Dr. Knox.—These models were shown. They consisted of the vendace, the mackerel, the red spotted trout of England, and the Lochmaben trout. This method of modelling will ultimately be preferred to all others, even that in wax.

Mr. R. Ball thought this process superior to those in use.—Sir J. Richardson advised, that if the process was employed, the skin also should be preserved. He wished to know of Dr. Knox the method of Dr. Thibert. Dr. Knox replied, that he was not at liberty to state more than that it was a plaster cast painted.

A paper was read from Dr. Bell Salter, giving directions for the guidance of botanists in their excursion to the Isle of Wight, and giving a list of flowering plants of interest found in various parts of the island.

Mr. Gould exhibited several new species of humming birds from the Andes.

Prof. Allman read a paper on a new species of Algæ.

A paper was read by Dr. Lankester from Mr. B. Clarke, 'On the Foliage and Inflorescence of the genera Phyllanthus and Xylophylla.'—The leafy appendages from which the flowers in most of the species of these genus spring have been described by authors in general, up to the present time, as branches. The author, having examined their structure and relations closely, has come to the conclusion that they are in almost all cases true leaves.

Mr. W. Hogan read a paper 'On Potatoes raised from Seed, as a means of preventing the extension of the prevailing disease.'—He first read extracts from German publications, giving the result of the trial of growing potatoes from the seed of the plant, which had been found to be successful as far as the production of tubers, and also the preventing the prevailing disease. Mr. Hogan had also tried the same process with success. The proceeding consisted in growing the seeds first in a hot-bed, and then transplanting. He considered this to be a successful way, because the most natural.

Mr. M. Stirling stated that he had, some time since, recommended to the government of Sweden the plan of procuring potato seed, and deriving thence the crops. He had advised giving prizes for the best seedling potatoes, and he also recommended hybridizing the potato as a means of improvement.—Mr. W. Ogilby thought growing potatoes from the seeds might prevent the scurf and dry rot, but not the present wet rot of the potatoe. He quoted several instances in which seedling crops had been destroyed. He had been most successful in growing potatoes from a little tuber which sprung from the "eyes" of the old ones going to decay.—Dr. Crook attributed the attack in the year 1845 to "cold." The cold burst the vessels, and then came the disease. Heat produces the same effects as cold; it bursts the tissues of the vessels, and the consequence is disease. Dr. Daubeny did not think that atmospheric changes had anything to do with the disease at all. He thought that the most satisfactory theory was that which referred the disease to fungi. He had understood that there was no potato disease in the neighbourhood of the copper furnaces in Swansea.—Dr. Buckland had lately visited Prof. Payen, who advocated the doctrine that the disease arose from fungi; and he (Dr. Buckland) believed so too. There was, in fact, a fungiferous miasm existing, which, like cholera, attacked not all, but those who were pre-disposed. It was the weak and intemperate that were attacked with cholera; it was the debilitated potato that had the disease. Extreme conditions of temperature debilitated the potato, and then it became diseased. The potatoes were suddenly attacked. He knew a case in which a whole field became diseased in three days. He believed the only remedy was mowing down the haulm of the potato the moment it was attacked.—Prof. L. Playfair was certain of one thing—and that was that the disease was not due to fungi. The nature of it was evident, as it could be produced artificially. If you scraped a potato and placed it in the open air, it became diseased;—and, in the course of a few hours, the fungi would appear on it.—Mr. E. Solly believed that the disease depended on chemical changes, not on the attack of a fungus.—Mr. Bush had examined the diseased potatoes under the microscope, and in its early stages had always failed to discover the slightest indication of the existence of a fungus. As the disease advances, first one fungus appears, and then another,—and at last animated life. This was the progress of all vegetative decay. The disease always commences on the outside of the potatoe, and proceeds to the centre. He had also found the disease constantly attended with the developement of crystals of oxalate of lime.—Prof. Balfour stated that some fungi attacked living and healthy structures,—others only diseased ones. The fungus of the potatoe was a botrytis; which he believed attacked healthy structures.—Mr. A. Strickland said, in reference to Dr. Buckland's recommendation to mow down the potatoes, that, when his neighbours mowed down their potatoes, he dug his up. They had lost nearly all theirs, whilst he had saved nearly all his.—Dr. Lankester observed on the want of evidence to support the theories of either cause or remedies that had been brought forward. Cold and heat had been assigned as causes, by destroying the tissues of the potatoe; but no destroyed tissues had been shown to exist. Debility had also been supposed to exist; but no proof was given of the existence of debility;—and the Dean of Westminster himself had admitted that he had seen the healthiest potatoes destroyed in three days. Positive observation was evidently opposed to the fungus theory. As to the remedies recommended, seedlings had been known to be attacked in more cases than they had escaped; and, therefore, sowing the seeds could not be recommended. Mowing down the stalks had not been more successful than letting them alone;—and it ought now to be known, that this Meeting had done nothing more valuable than to show the insufficiency of all theories and remedies hitherto advanced.

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THURSDAY.

*Section E.—Physiology.*

*President*—Prof. Owen.

Dr. Fowler read a paper 'On the Relations of Sensation to the higher Mental Process.'

The Secretary read a paper, by Dr. Searle, 'On the Cause of the Blood's Circulation through the Liver.'—After alluding to the powers which circulate the blood in the system generally, the author declared it to be still a problem by what combined forces the portal circulation was carried on in the liver,—one cause of the general circulation being apparently absent, namely, the oxygenation of the blood in the arterial system, in the blood the portal system being deemed wholly venous. The solution of the problem depended, he thought, on the fact that the stomach and bowels were (like the cutaneous) a respiratory surface, by which the portal blood becomes oxygenated to the necessary degree. In support of this view he adduced the experiments of Majendie, who found 11 per cent. of oxygen in the stomach of criminals examined after decapitation, and carbonic acid and nitrogen in the intestines; the source of this oxygen he believes to be the air swallowed with the food and saliva, and in combination with cold water. This oxygen he believes to be absorbed by the veins and lacteals, and communicated as a source of power to the portal vessels. He deemed the absorbing power of the gastric and mesenteric veins to be increased by the diminution of the quantity of blood in the vessels by the secretion of bile. In conclusion, he thought the ruminant animals required an additional supply of oxygen to maintain the respiratory function over their large gastro-intestinal surface, and that this was supplied from their peculiar function of rumination.

FRIDAY.

Prof. Owen in the chair.

Dr. H. Bennet read a paper 'On a peculiar form of Ulceration of the Cervix Uteri,' which was of purely practical interest.

A paper, by Prof. Retzius, 'On the Ethnological Distribution of round and elongated Crania,' was read.—On this paper a lengthened discussion arose on the degree to which physical peculiarities of races may become modified by climate, education, progress of civilization, and the effect of dwelling with higher races. Mr. Lyell gave it as the result of his recent observations in the Southern States of America, that the Negro race is much altered by living even for a few generations with the white races, and always for the better, even when no mixture of races exists; and that where it does exist, the result is ever to retain and propagate the higher developements of the white races.

Dr. Carpenter read a paper 'On the Physiology of the Encephalon.'—The object of this communication was to bring under consideration the inferences to which we are led by the study of Comparative Anatomy, in regard to the functions of different parts of the human encephalon.

A lengthened discussion followed the reading of this paper, in which Dr. Laycock denied that we had yet a sufficient number of facts ascertained either to deny the higher mental processes and emotions to the lower animals, or to induce consent to the physiological distinctions drawn by Dr. Carpenter from the anatomical structures in man and mammalia. He defended his dissent by facts in natural history, and physiological and anatomical views relative to the encephalon published by himself, two years ago, in papers read before the Association.

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THURSDAY.

*Sub-Section E.—Ethnology.*

*President*—Dr. Prichard.

Dr. R. G. Latham in the chair.

The Secretary read a paper, by Mr. W. Bollaert, 'On the Comanche Indians.'—These the author stated to be a Texian tribe of native Indians, who were devided into three divisions:—1. The Comanche or Zetans. 2. The Lembrack. 3. The Tenukes. They constituted the largest native tribe in Texas, they possessed few traditions, and were unacquainted with agriculture; consequently their habits were migratory. During war, they acknowledged one chief; they had an idea of a future state, but of a very gross nature, believing in the existence of evil spirits and witchcraft. The author, in conclusion, gave some remaks on their mode of conducting war and on their treaties.

Dr. Latham communicated a paper, by the same author, 'On the Indians of Texas.'—This consisted of an enumeration of the distinct tribes which were now, or had been, known in Texas. They formed a catalogue of thirty-five tribes. Some of these were derived from the Comanches—others were either wholly or nearly extinct. The manners of a few of the most considerable were alluded to.

Dr. Latham read a paper containing 'Remarks on a Comanche Vocabulary.'—After a careful examination of the vocabulary with that of other tribes, the author came to the conclusion, that the evidence of language determined the special affinities of the Comanche tribes to be with the Snake or Shoshonie Indians.

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*Section F.—Statistics.*

*President*—Mr. G. R. Porter.

The first paper read (by Dr. C. Taylor) was a 'Report on the Medical Relief to the Parochial Poor of Scotland under the Old Poor Law,' by Dr. Alison.—It stated that as the objections made by Dr. Chalmers and others to establishing a legal and adequate provision for the poor in Scotland did not apply to medical relief, the efficiency of that relief, under the old Scottish law, would be a fair test of the efficacy of the voluntary system of charity. An association of medical practitioners was formed at Edinburgh, in November 1845, to collect information on the subject. It appeared that in Edinburgh there was no provision for medical relief from the poor-funds, except for the in-door paupers in the charity workhouse. Previous to 1815 no assistance was ever given to the sick poor at home; and though since that period the duty has been gratuitously undertaken by the officers of several dispensaries, it had not been effectually or regularly performed. In the Canon-gate the dispensary aid to the poor came to a sudden close in the midst of the late epidemic fever, in consequence of the death of one of the medical officers who had acted as treasurer. By the recent Act ten duly qualified and paid officers have been appointed to take charge of the sick paupers in the different districts; but Dr. Alison lamented that the provision had been abandoned which compelled the parishes to *combine* in giving relief, as in Edinburgh the rich congregate at one extremity of the city and the poor at the other. In Glasgow relief has been given by paid medical attendants for some years. Returns were obtained from 40 towns, exclusive of Edinburgh and Glasgow;—from which it appeared that in 16 of these towns there was absolutely no *requited* medical relief, either from the public authorities or from voluntary subscriptions. In 4, an occasional payment, never exceeding a few shillings, had been made on special occasions, In Campbelltown 10*l.* was allowed to the professional men during the epidemic fever. In Kirkintilloch a similar sum was given, but by a private individual. In Dundee during the same fever 5*l.* each was allowed to six dispensary surgeons. In some other places 2*l.* was given to a surgeon; and in others a small allowance was made for drugs. In anticipation of the new Poor Law, 10*l.* has been allowed annually for medical relief in Alloa. In Dunbar 6*l.* 6*s.*, but this includes the supply of drugs. In Dunfermline 20*l.* a year, not including drugs. In Greenock 25*l.* per annum has been paid to each of three district surgeons. In Kilmarnock 10*l.* each to three surgeons. In Week 15*l.* is divided between two surgeons. In Dumfries 10*l.* to one surgeon. The unrequited medical labour is stated by twenty-five gentlemen, and ranges from 5*l.* to 220*l.* annually in value, giving an average of 40*l.* per year. But this is not the only tax levied on the charitable feelings of medical men;—in 90 per cent. of the cases they had to furnish wine, food, &c., out of their own substance; and in 33 of the 40 towns brought under review, no change has been made in this system. Passing over the returns of infirmaries and dispensaries supported by voluntary contributions as rather imperfect, we come to the medical relief in the rural districts. The number of returns made amounts to 325. Out of these, 94 have received some remuneration, but only 39 annually. Of these 39 only 13 have received sums above 5*l.*; 26 above 1*l.* and less than 5*l.*; and 9, 1*l.* or under. 10 are paid by the bounty of private individuals; and of these 1 is paid 60*l.* by a nobleman, and another 40*l.* by a landed proprietor; both, however, have the charge of expensive districts, and as there is no fund on which they can draw for drugs or necessaries, there are large drawbacks to be made from the remuneration. 23 have received gratuities for their services, chiefly during the prevalence of epidemics. In one case this gratuity amounted to 20*l.*; in 14 it was under 5*l.*; in 2 cases it was only three shillings. In one of these cases this three shillings was the only remuneration for twelve years' attendance on paupers averaging 70 constant and 13 occasional patients: in the other, the three shillings was a remuneration for passing paupers of other parishes, and *nothing was allowed for twenty-one years of attendance on resident paupers*, averaging 44 constant on the district roll. 211, or above 60 per cent., have never received any remuneration of any kind for their professional attendance on the parochial poor, or for the drugs which they have deemed it necessary to supply to them; and 208 add that they have had occasion to give wine, food, &c. from their own limited funds, and that they had occasion to defray all travelling expenses when they made distant visits. 136 have estimated the money value of the unrequited labour which they have bestowed on the parochial poor:—it amounts to 34,447*l.* annually, or an average of 283*l.* each. The complaints of inattention to sick paupers by the parochial authorities are all but universal; and when applications were made for the repayment of different outlays, they were almost invariably refused. It was stated that since the abstract presented to the British Association had been compiled, several additional returns had been obtained; but they in no degree tend to weaken the general impression likely to be produced by the preceding statement, and it was therefore deemed unnecessary to tabulate them.

A brief conversation arose on the amount of benevolent sacrifice made by the medical profession generally; and hopes were expressed that the evils exposed by Dr. Alison would disappear under a better administration of the new Poor Law.

The next paper was 'A Review of the Mines and Mining Industry of Belgium,' by R. Valpy, Esq. of the Board of Trade.—It stated that, as a coal-producing country, Belgium ranked the second in Europe.

In 1838 the total number of coal mines in Belgium was 307, with 470 pits in work, and 172 in process of construction, employing 37,171 persons; being an increase of 8,454, or 28 per cent. on the number employed in 1829. The increase of the quantity of coal raised was not accurately ascertained, but it appeared to be about 37 per cent. The average cost of production is 10*s.* 8*d.* per ton, and the average price 23*s.* 1*d.* for first quality, and 16*s.* 6½*d.* for second quality of coal; the average rate of wages is 1*s.* 6*d.* and 3-10ths of a penny per day. The establishments for preparing other mineral productions for market in 1838 were, for iron 221, copper 8, zinc 7, lead 2; the total number of furnaces was 139, of which 47 used coke and 92 charcoal. The total number of accidents from 1821 to 1840 was 1,352, which occasioned severe hurts to 882, and deaths to 1,710, making a total of 2,592 sufferers.

No discussion arose on this paper.

It was resolved that Dr. C. Taylor should be added to the Secretaries of this Section, and Mr. Kenrick to the Committee.

FRIDAY.

A Railway Map of England with an Explanation, contributed by Mr. Beaumont, was laid before the Section,—but the explanation was so indefinite that it was difficult to discover what were the author's objects, and in his absence it was found impossible to discuss the subject beneficially.

Mr. Heywood read a paper 'On the Educational Statistics of Oxford,'

—He described the almost exclusive attention paid to classical studies and the neglect of mathematical and physical pursuits.

Dr. C. TAYLOR, at the request of the President, stated the system pursued in the Dublin University, dwelling particularly on the system of examination at the end of every term, and the strictness of the entrance examination by which emulation is created in classical schools.

Dr. C. TAYLOR was again requested by the President to give some account of the University system of France. He stated that under the term "University" was included the whole national education of France; and the points on which he dwelt was the great attention paid to design in all the schools; the introduction of standard French authors into the course of polite literature in the same rank as the ancient classics; the introduction of an extensive course of ancient and modern history as a necessary part of the collegiate curriculum; and the establishment of a distinct course for young men designed for mercantile pursuits, or for professions not requiring an extensive knowledge of the ancient authors.

The Rev. Prof. ELTON then, at the request of the Chairman, gave an account of the condition of academic education in the United States of America. He stated that the system of terminal examinations was similar to that of Dublin; but that the courses were more extensive and the examinations more severe in the New England Colleges than in those of the Southern States. He dwelt at some length on the advantages which had resulted from separating the colleges from the theological seminaries, and stated that in most of the latter previous graduation in a college was a necessary condition of admission.

In reply to a question from Mr. Heywood, Prof. ELTON reported that the experiment tried at Harvard University of allowing young men the option, at the end of the first year, of pursuing the study of modern, instead of ancient, languages had not been found to work well, and was likely to be abandoned.

Mr. M. PHILIPS called attention to the neglect of living oriental languages in England, such as Chinese, Turkish, Malay, &c., and trusted that some means would be devised for facilitating the study and encouraging young men to the pursuit. There was not at this moment a professor of Chinese or Turkish in any English collegiate establishment.

In consequence of the absence of Dr. Laycock, who was to have read a paper 'On the Statistics of York,' the Section adjourned.

SATURDAY.

The Secretary read a paper, from Mr. WIGGLESWORTH, 'On the Mortality of Children,' and expressed his regret that the absence of the author must prevent both himself and others from receiving explanations on some portions of the paper which seemed rather doubtful and obscure.

The second paper read was 'On Plate Glass-making in England in 1846, contrasted with what it was in 1827,' by Mr. H. HOWARD.—The writer furnished carefully all the materials for establishing this comparison. Amongst other results he stated, that in 1827 plate glass was sold for about 12*s.* average per foot, to the extent of about 5,000 feet per week; in 1835, for from 8*s.* to 9*s.* per foot, to the extent of about 7,000 feet; in 1844, for from 6*s.* to 7*s.* per foot reaching about 23,000 feet; and in 1846, for from 5*s.* to 6*s.*,—about 40,000 feet per week. The sale is now about 45,000 feet weekly. He mentioned that, in 1829, a plate glass manufactory ceased operations because of the small profit realized when selling at 12*s.*; while, in 1846, a company, with a paid-up capital of 130,000*l.*, realized a net profit of 30,000*l.* selling at from 5*s.* to 6*s.* Looking at this extraordinary increase, in spite of the severity of excise restrictions, the author asks, what would be the probable demand if the price were reduced to 4*s.* or 3*s.* 6*d.* per foot—which, free as the trade now is from excise interference, would yield an ample profit?

Col. SYKES then read a supplement to an elaborate account 'Of the Civil and Criminal Statistics,' illustrating the administration of justice in the four Presidencies of India, which he had read to the Statistical Society of London, March 20th, 1843. The tables he presented were very voluminous, and entered into the most minute details.

The Secretary read a report 'On the Statistics of Sickness and Mortality in the city of York,' furnished by Dr. LAYCOCK. The report stated that it was desirable to have a more perfect system of registration; and recommended that the hour of decease, the length of residence in the place of death, and in the locality previously occupied, and the state of the surviving family, should be recorded.

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FRIDAY.

*Section G.—Mechanics.*

*President*—Rev. Prof. WILLIS.

The proceedings of this section did not commence till to-day, when the chair was taken by Mr. Scott Russell.

DR. ROBINSON gave an account of a 'Modification of Dr. Whewell's Anemometer,' for measuring the velocity of the wind. He explained to the section verbally the nature of the various anemometers hitherto employed to measure the *force* of the wind, and distinguished Whewell's from them, as a measure merely of comparative *rate*. The fault of it was, that the instrument gave no absolute measure of velocity in miles per hour, and that it reduced the rates to no standard, and therefore the observations made at one observatory were not capable of comparison with those at another.

Mr. VIGNOLLES read a paper furnished by M. Arago, for the purpose of being communicated to the Association, M. Arago himself being prevented by illness from attending. 'On a new method of Boring for Artesian Springs,' by M. FAUVELLE, of Perpignan, in France. The paper was an abridged translation of M. Fauvelle's own account, in which he says:—"In 1833, I was present at the boring of an artesian well at Rivesaltes; the water was found, and spouted up abundantly. They proceeded to the tubing, and for that purpose enlarged the bore-hole from the top downwards. I was struck by observing that it was no longer necessary to draw the boring tools to get rid of the material, and that the water, rising from the bottom, brought up with it, in a state of solution, all the soil which the enlarging tools detached from the sides. I immediately observed to my friend, M. Bassal, who was with me, 'This is a remarkable fact, and one very easy to imitate; if, through a hollow boring road, water be sent down into the bore-hole as it is sunk, the water, in coming up again, must bring with it all the drilled particles.' On this principle I started to establish a new method of boring. The apparatus is composed of a hollow boring rod, formed of wrought iron tubes screwed end to end: the lower end of the hollow rod is armed with a perforating tool, suited to the character of the strata which have to be encountered. The diameter of the tool is larger than the diameter of the tubular rod, in order to form around it an annular space through which the water and the excavated material may rise up. The upper end of the hollow rod is connected with a force-pump by jointed or flexible tubes, which will follow the descending movement of the boring tube for an extent of some yards. This boring tube may be either worked by a rotatory movement with a turning handle, or by percussion with a jumper. The frame and tackle for lifting, lowering, and sustaining the boring tube offer nothing particular. When the boring tube is to be worked, the pump must be first put in motion. Through the interior of the tube a column of water is sent down to the bottom of the bore-boles, which water, rising in the annular space between the exterior of the hollow boring rod and the sides of the bore-hole, creates an ascending current which carries up the triturated soil; the boring tube is then worked like an ordinary boring rod, and as the material is acted upon by the tool at the lower end, it is immediately carried up to the top of the bore-hole by the ascending current of water. It is a consequence of this operation that the cuttings being constantly carried up by the water, there is no longer any occasion to draw up the boring tube to clear them away, making a very great saving of time. Another important and certainly no less advantageous improvement is, that the boring tools never get clogged by the soil; they work constantly, without meeting obstructions through the strata to be penetrated, thus getting rid of 9-10ths of the difficulties of boring. In addition, it should be mentioned, that experience has shown there are no slips in any ground which ordinary boring rods can penetrate; that the boring tube works at 100 yards in depth with as much facility as when only 10 yards down, and that from the very circumstance of its being a hollow rod, it presents more resistance to torsion than a solid rod of equal thickness, and quite as much resistance to traction; these are the principal advantages of the new system of boring. Indeed, these advantages have been fully confirmed by the borings which I have just completed at Perpignan. This boring was commenced on the 1st July, and was completed on the 23rd, by finding the artesian water at a depth of 170 mètres (560 English feet). If from these 23 days, each of 10 hours' work, are deducted three Sundays and six lost days, there remain 14 days, or 140 hours of actual work; which is upwards of one mètre per hour, that is, 10 times the work of an ordinary boring rod. In the method I have described, it will be perceived that the water is injected through the interior of the boring rod. Experience has taught me that when gravel or stones of some size are likely to be met with, it is better to inject the water by the bore-hole, and let it rise through the boring tube. The additional velocity which may be thereby given to the water, and the greater accuracy of calibre of the tube, allow the free ascent of all substances which may be found at the bottom of the bore-hole, and which the former mode of working may not so readily accomplish. I have brought up by this latter way stones of six centimètres long and three thick ($2\frac{1}{2}$ by $1\frac{1}{4}$ English inches). The idea of making the water remount through the interior of the boring tube suggests an easy mode of boring below a film (sheet) of flowing water; it would be sufficient to close the orifice of the bore-hole hermetically, still, however, so as to allow the boring tube to work, but yet so that the flowing water should be always forced down to the bottom of the bore-hole to find its way to a vent; it would thus draw up and carry away all the detritus. If, in addition to the above, we consider the possibility of making the hollow stem of the boring rod of wood, and of balancing it so that it would weigh no more than the water in which it has to move, the problem of boring to depths of 1,000 mètres (1,100 yards) and upwards would appear to be solved. In the square of St. Dominique, at Perpignan, a boring had heen carried on upon the old method for upwards of eleven months for the purpose of forming an artesian well, and the water had not been found." Fauvelle placed his new tube alongside the old horing tackle, and soon got down to a depth of nearly 100 yards, when an accident occurred which would have required some days to remedy. Fauvelle decided upon abandoning the hore-hole already sunk so deep, and commencing a new one, satisfied that there would therehy be a saving in time. The rate of sinking was equal to four English feet per hour of the time the hollow boring rod was actually at work, the depth of 560 English feet having been obtained in 140 working hours, for a bore-hole of about six English inches in diameter. M. Arago, who had seen the rods of Fauvelle at work, mentions how fully they answered, and that the large powerful tools at the bottom of the hollow boring rod cut easily through the hardest strata; he confirmed the fact of the large sized stones and gravel coming up with the ascending current, having himself watched them. He also mentioned, that such was the opinion of the people in the vicinity of Perpignan, and so much was water wanted, that orders for the sinking upwards of 200 artesian wells had been given to Fauvelle. The introduetion of this system into this country, especially if combined with the Chinese or percussive system of boring, as practised with bore-holes of very large diameter, at the Saarhruck mines, and at many other places on the Continent, must be productive of great henefit, and would not merely effect a saving of money and lahour, but the paramount advantage of immediately solving the question of the existence of coal, minerals, water, &c.

Sir John Guest asked Mr. Vignolles to explain the system of percussion boring, for the information of those gentlemen present who might not he acquainted with it.—Mr. Vignolles said, instead of boring with augers or rods, there was a heavy weight suspended hy a rope and pulley; and fixed to the bottom of the weight was a tool of the crown form, viz., a circular tool of iron, indentated at the bottom. There was no description of rock on which he had tried it that this tool did not penetrate with facility. The prejudice of English workmen, however, had hitherto prevented its introduction in this country; hut he had no doubt it would make its way, particularly if it could be combined with Fauvelle's system.—J. Lobb, Esq., Mayor of Southampton, wished to ask a question relative to the applicability of Fauvelle's plan to the horing of the Southampton artesian well. They had got to the depth of 1,200 feet with a bore 6 inches in diameter, and the expense had been nearly 20,000*l.*; this system, however, seemed to diminish the expense of horing in an extraordinary manner; and he wished to ask if it could be applied to the present boring at the Southampton Common?—Mr. Vignolles, as an engineer, had no hesitation whatever in saying that it could he applied without difficulty. If they wanted force to send the water down the tube, they might use a steam-engine.—Dr. Robinson suggested that a deputation from the Section should go to the works of the Southampton well, and inspect them.—Mr. J. Hill said that percussion had long been used in this country. They had used that plan whenever they came to hard substances in the Southampton boring. The rods were drawn up by a windlass, aud dropped down a foot or six inches; and after the material was loosened the rods were drawn, and the pulverized material raised up by a cylinder.—Mr. Vignolles said this was different from the Chinese system of percussion, where a rope was used, which saved the trouble and loss of time in drawing the rods. The power required for sending down the water on Fauvelle's plan was much less than might be supposed.—The Marquis of Northampton suggested that a committee of the Geological Section should be invited to accompany the committee from this Section.—Dr. Lankester expressed his warm approval of M. Fauvelle's plan, and his opinion of its applicahility.—A conversation followed, in the course of which Sir John Guest said the weight of a hollow rod, three inches in diameter, and the iron a quarter of an inch thick, would be less than that of a solid rod of an inch diameter: the weight would he further lessened hy the rod floating in water.

MONDAY.

His Royal Highness Prince Albert paid Southampton another visit this day, for the purpose of attending the different sections. The Mayor, Joseph Lobb, Esq. conducted His Royal Highness to the reading-room, where a very appropriate address was presented to him, expressive of the great honour the town felt in having been visited for a second time in so brief a period by His Royal Highness.

The excursion for the Geological Section, accompanied by about 300 of the members and associates, to the Isle of Wight, on Saturday, was everything that could he desired. The day was delightfully fine, and the whole was an intellectual treat of no ordinary character.

In the course of Saturday the Botanical Section visited the splendid gardens of the Dean of Winchester (the Rev. Mr. Garnier) at Bishopstoke.

TUESDAY.

The third evening (Tuesday) meeting of the association was held at the Victoria Rooms.

The subject for the evening was a discussion, by Mr. Lyell on the valley and delta of the Mississippi, and other points in the geology of the United States, from observations made by him during his recent scientific tour in that country.

The president took the chair at eight o'clock, and introduced the learned lecturer to the meeting.

Mr. Lyell, who was loudly cheered on coming forward, proceeded to give a graphic and interesting description of the physical peculiarities of that immense tract—the valley of the Mississippi. One of the most remarkahle features of this vast district is the delta which, for nearly fifty miles of its extent, presents the extraordinary peculiarity of having a vast river running nearly parallel with the sea, from which it is in some places separated by an embankment of only half a mile across. The mouth of the river where the stream is arrested hy the sea is crossed hy a bar, over which there is but eighteen feet of water; hut if this obstruction were removed, all the fleets of the world might advance for between 1,000 and 2,000 miles into the interior. The most remarkable peculiarity of the delta and the valley is the low and nearly level appearance of the country. For 150 miles from the Gulf to New Orleans there is a rise of only 9 feet, and the slope still farther inland is equally trifling. He had an opportunity of seeing at New Orleans an excavation which had been made for some works to the depth of 18 feet, and the soil throughout was formed principally of timber. The trunks and roots of the trees were in may places in their original position, showing that they must have grown in a situation 9 feet below the present level of the sea. This he could only account for by supposing that there had been a gradual subsidence of the soil. He distinguished the delta from the alluvial soil above, as including all the district helow the first arm that the river sends to the sea. The slope above the delta is nearly equally gradual as below, heing generally only about an inch, and never more than half a foot of elevation in a mile. This uniformity may he explained by the fact that the moment the river reaches the banks, it overflows, and so the velocity, which is ordinarily only four miles an hour, is instantly checked. The debris carried along by the flood is deposited over the surrounding plans, the principal part being left near the bed of the river, the necessary result being that the banks have been gradually raised to a higher level than the lands adjoining them. This slope from the river interior is as much as 18 feet in a distance of a few miles. The interior consists of vast swamps, covered with trees, the tops alone of which are visihle in time of floods. Sometimes the inhabitants, on the banks of the Ohio or Red River, after making a large raft, on which they prepare to bring all the produce of the year, find themselves near the termination of a journey of some two months, entire weeks of which may have been passed by them aground waiting for a flood to float them off again, suddenly hurried through one of the openings which the river makes in its banks at the rate of 10 or 12 miles an hour, and left a-ground in the middle of a vast morass, where they are obliged to climh a tree for safety, and await the chance of a hoat coming to their rescue.

After an eloquent peroration on the importance of geological study, and on the value of such associations as that which he addressed, in promulgating its truths, the learned gentleman concluded by announcing a fact most important to geologists—namely, that he had been enabled to confirm the discovery made hy Dr. King of an animal in the coal formation, as he distinctly traced the footsteps of a huge saurian reptile in the Pennysylvanian coal strata. Mr. Lyell was loudly cheered at the conclusion of his address, which occupied nearly two hours in its delivery.

The meeting immediately afterwards separated.

All the sections opened at the usual hour this morning, and the attendance at many of them was considerable throughout the day.

*Section A.—Mathematical and Physical Science.*

This section did not meet until half-past twelve o'clock; Sir J. F. W. Herschell, Bart., the president, in the chair.

The papers received on magnetism and electro-physiology formed the principal subject of the proceedings of this day. Some of the memoirs read were of considerahle interest.

The Rev. Dr. Scoresby made some observations on the phenomena of magnetism in steel and iron, in continuation of his paper read at the last meeting of the association. During the past year he had made some additional discoveries, or rather improvements, in the details which he had then announced. These were confined to the process of developing the magnetic power in bars of steel or iron by manipulation. He proceeded hy experiment to show the mode which he adopted. He arranged twelve steel bars, averaging each about six inches in length, half an inch in width, and three-eighths of an inch in thickness, on a board, so as to make them form a connected line according to Mitchell's plan. He then applied the centre of a small piece of polished hoop iron to the magnet, placing the pole which he wished to develope a little in advance, and passed this novel kind of smoothing iron over the twelve bars, and after turning up the under side of the bars, again repeated the process. By this means, though the magnet was only one of some ounces in weight, a magnetic power was developed in the bars sufficiently strong to sustain them together when held up by one extremity. He could magnetise a single bar by the same mode of operation first rubbing the iron plate suspended from the horse-shoe magnet slowly along one side, and then in the same direction across the other in the same manner as before; and he had often operated on 500 bars, each half an inch thick, by the same means. He found that by neutralising the poles of the magnet, by applying it to the centre of the iron plate he considerably increased its power. The power developed in the bars was very considerable when a small magnet was used. With a 3lb. magnet he obtained the maximum power of development, but with a very powerful magnet of 8lbs. the development was, strange to say, materially diminished. In the latter case it also happened that bars of inferior steel were so overpowered by the magnet as to have the poles developed in the wrong way. He mentioned several curious results, showing that the magnetic power developed in the bars was proportionate to the superiority and hardness of the steel, and added, that it was probable we did not get the 100th or 1,000th part of the real power of the bars magnetised. His 3lb. magnet had a retaining power of ten times its own weight, and a retainiug power of fifteen or sixteen times the weight of a magnet was considered very considerable. There was, however, then exhibiting in the town, a magnet having the retaining power of 100 times its own weight.

Dr. GREEN read a paper 'On a new Equatorial Mounting for a Telescope.' The plan was intended to give greater steadiness to the stands of small telescopes than that designed by the late Sir Wm. Herschell.

*Section B.—Chemistry.*

*President*—M. FARADAY, Esq.

Papers were read in this section from Mr. Mallet, 'On the Corrosion of Iron Nails in and out of use.' 'On the solubility of the Fluoride of Calcium,' by Dr. WILSON; and on some other matters of a nature too purely technical to be interesting to the general reader.

*Section C.—Geology and Physical Science.*

*President*—LEONARD HORNER, Esq.

Professor AGASSIZ brought forward a report on the fishes of the London clay. It was one of the utmost interest, as the learned author has acquired a greater reputation in this particular branch of paleontology than any other living man; but any attempt at describing the distinctive features of the varieties of fossils explained without the figures by which the memoir was illustrated would be impracticable.

Interesting papers were also read by Professor ANSTED 'On General results of the examination of the coal of Northern India, being an analysis of the report communicated to the Indian Government;' and by Mr. R. BALD, entitled 'Observations on the musket-band, commonly called the black-band, ironstone of the coal-field of Scotland.'

*Section D.—Zoology and Botany.*

SIR J. RICHARDSON, M.D., the president, in the chair.

Mr. OGILBY read a paper from Mrs. Whitby, of Newlands near Lymington, Hampshire, 'On the Production of Silk in England.' Mrs. Whitby fed her silkworms principally on the *morus multicaulis*, or that known as the Philippine variety of the mulberry tree. This plant grows rapidly from cuttings, and produces large leaves. The silk produced was found to be of a superior quality, and of a higher value than any imported. The mulberry trees which were first planted in 1836 were in a most flourishing condition, and the only difficulty which she found in rearing the silk worms was in preventing the eggs from being hatched before the leaves of the mulberry appeared. To meet this diffiulty she planted some slips of the mulberry under a frame in the autumn, and these bore leaves in the spring sufficient to feed the young caterpillars, until the general crop came into bloom. The total expense for a year, including rent of land and cost of eggs, attendance, &c., was £50, with 10 per cent. loss, making in all £66. 0s. 11d., and the total value of the silk produced was £160. 9s. 4d. leaving a net profit of £94. 8s. 5d.

Some discussion ensued on the possibility of employing the poor in England and the south of Ireland in the cultivation of silk, and considerable doubt appeared to be entertained as to the possibility of feeding the silk worms occasionally on lettuce, sow-thistle, and other succulent plants.

'On the true character of the tendrils of the Cucumber,' by Dr. BELL SALTER.

Professor E. FORBES described some new and rare marine animals dredged in the British seas since the last meeting.

*Section F.—Statistics.*

G. PORTER, Esq., Vice-president, in the chair.

"Statistics of Crime in England and Wales during the years 1842, 1843, and 1844." By F. G. P. Neison, F.L.S.

The object of the author in bringing forward this paper was to show, from the criminal returns for England and Wales, the necessity of considering age as an element in all inquiries into the nature and progress of crime, and to point out that at some periods of life the tendency to crime was more than quadruple that at other periods of life. Tables were prepared showing the relation of the number of criminals in England and Wales to the population at the different terms of life, and a curious law seemed to prevail, by which it appeared that in the male sex, from the age of twenty upwards, the tendency to crime in each decennial term of life, is exactly 33 1-3d per cent. less than in the term of life immediately preceding, and in the female sex, the tendency to crime in each decennial period of life is 25 per cent. less than in the period immediately preceding; thus pointing to the existence of some very powerful element in crime, which it is important to discover, to afford satisfactory means for the treatment of criminal offenders.

This section having completed its business, adjourned to the 24th of June next.

*Section G.—Mechanics.*

Rev. Professor WILLIS, chairman.

Mr. SCOTT RUSSELL read a paper from Mr. Eyton, a practical engineer, "On Improvements in Marine Steam-engines." The principal improvement suggested was a self-acting stop-valve between the boilers. By this arrangement the valves were kept in constant motion, making a peculiar noise, an interruption in which gave notice of any injury to either of the boilers, and thus it was hoped many accidents might be prevented. Another of the suggested improvements was a contrivance for preventing the accumulation of scales in the boiler.

A paper was also read by Mr. Lamb on certain improvements, which he suggested in the construction of steam-engines, a description of which invention will be found in another page.

WEDNESDAY.

Sir R. MURCHISON, the president, introduced Mr. Grove, the eminent chemist, to the meeting. The matter selected for the proceedings of this evening, it should be observed, comprised an explanation by Mr. Grove of his own recent descoveries of the decomposition of water by heat, and also an account of M. Schonbein's extraordinary invention of the explosive cotton.

Mr. GROVE concluded by explaining his own great discovery of the separation of water into its constituent elements by heat.

Sir JOHN HERSCHEL remarked that one of the most extraordinary scientific facts of the past year was that of the comets having divided into two, each of which proceeded on its way alone. He would probably have some remarks to bring before the association on this subject at a future time.

The meeting after hearing some explanatory remarks from Mr. Grove, separated.

*Section B.—Chemistry.*

There were six papers read at this section, but there was only one of any general interest among them.

'On certain principles which obtain in the application of manures. By W. C. SPOONER.'

*Section C.—Geology and Geography.*

*President*—LEONARD HORNER, Esq.

This section sat for a short time and afterwards proceeded to visit the Artesian Well on the common, near the town.

*Section D.—Zoology and Botany.*

*President.*—SIR JOHN RICHARDSON, M.D.

'On mould containing phosphorescent vegetables. By the Honourable W. FOX STRANGWAYS.' The luminous matter described in the paper was found attached to the roots of some mosses on a hill near Alexandria. No attempt at explaining the phenomenon was made.

*Section G.—Mechanics.*

The Rev. Dr. ROBINSON, vice-president, in the chair.

The proceedings at this section to day were looked forward to during the week with much anxiety, as the new wave principle in the important department of naval architecture was expected to be developed. The room was densely crowded during the meeting.

Dr. PHIPPS gave an account, which was of a most flattering kind, of the sailing powers of two sailing yachts, built by him on the wave principle. These were the Enchantress cutter and a smaller boat built for Dr. Corrigan, of Dublin. In the course of his remarks he observed that vessels of from

70 to 80 tons might be safely cutter-rigged, but above that tonnage the enormous weight and size of the mainboom would render such a rig unwieldy and dangerous. In smaller vessels it might be taken as a general rule that no plurality of sails would never effectually supply the place of one large sail.

The Rev. Dr. Robinson said, before calling on Mr. Russell, the author of the wave system of ship-building, to explain its principles, he would offer a few preliminary remarks on a subject involving so intimately the greatness and prosperity of this empire. There was a museum, which was easy of access, kept at Somerset-house, of the models of nearly all the vessels of war that had ever been built, and it was a most humiliating sight to perceive that, with the exception of the celebrated ship the *Great Harry*, and the *Sovereign of the Seas*, there was not a single model rising higher than that of a beast of burden in the entire, save some prizes taken from the French. During the war it was found that French vessels could always keep to the windward of the British ships, and then sail away from them when they liked, and it was solely owing to the indomitable spirit of the British sailors that so many great victories had been obtained. The superiority of the French ships he ascribed to the care taken by Louis XIV. to unite practical knowledge with superior science in this branch of national greatness. The few good Brittsh ships that had been constructed were made after French models, and even in these there was such an inferiority, that a number of small vessels built on the plan of a celebrated French corvette, were so bad as to be known in the service as *the forty thieves.* The writers on naval architecture, with the exception of Chapman and a few more, promulgated the most absurd rules and systems, and left the subject without any theoretic principles whatever to guide the builders. He would have asked the association before this to obtain a report on the practical principles of naval architecture, but that he really knew no one to whom they could apply with a prospect of getting a satisfactory answer. As an instance of the bad feeling existing on this subject, he had only to allude to the recent operations of the experimental squadron, where matters of fact had been made matters of party. He trusted, however, that at the next session of the association some better prospect would be before them. A few of the points on which information was wanted were these. The stability of the vessel to carry a snfficiency of canvass to obtain the necessary speed was an important consideration. This stability was to be obtained, either by lengthening the vessel, or still more by increasing the breadth, or else by deepening it. Each of these modes, however, bore with it a corresponding disadvantage; and some general theory of proportion was most desirable. The second point was to enable the vessel to move through the water with the least possible resistance. By increasing the stability of the vessel, they increased also the resistance, and that resistance was also considerably promoted if the vessel left a slough or vacant piace in the water at its stern. The third great object was to increase the power of the vessel to sail against the resistance of the wind, as in sailing near the wind her tendency to drift side-ways was much greater than going a-head. On none of these points had they any accurate theoretical knowledge whatever. The water-line, which was the line formed by the water on being first separated and then closing behind the vessel, was entirely unsettled, almost every ship-builder having some favourite theory of his own, without, however, being able to assign any reason for adopting it. The reverend gentleman then gave some particulars of the excellent sailing qualities of Dr. Corrigan's yacht, but said that it was probable the wave principle on which she was built might hereafter be still imprcved. At least there were some points on which he would like to cross-examine the inventor.

Mr. Russell then came forward, and after expressing his gratitude to the association for directing its attention to so important a subject, proceeded to explain the theory of what was known as the wave principle in ship building. He was first induced to direct his mind to this subject when the canal companies proposed some years ago to establish swift boats that might compete with the mail coaches. On being applied to by them, his first attempt was to build one with a spheroidal bow, but the result was not as successful as was to be wished. The favourite shape of bow among seamen at the time was that called a "duck's-breast, but the effect was to raise a large wave immediately in front of the vessel, which of course considerably retarded its velocity. He then directed his attention to the motion of the water itself. When a vessel passed through the water at a great velocity, a high wave was raised at the head, as high in the old steamers as four feet, and this wave on falling back formed a hollow by its pressure immediately behind it, and the water was afterwards sent out with great force on both sides of the bow. All this was a costly and useless expenditure of force. In endeavouring to ascertain the least resistance necessary to bring the particles of water out of a state of rest, he conceived that there ought to be a similarity between the motion of water and that of a pendulum revolving in a circle. and this led him to adopt the form known as the wave principle. This is different from a bow formed of two strait lines meeting at an acute angle, in being narrower thrn such a bow towards the cut-water, and a little wider towards the bow. The object to be attained was, he considered, to remove the particles of water rapidly, and at the same time not to throw them farther aside than the breadth of the vessel amid-ships. That this object was effected by the wave principle he ascertained in the following manner:—He got his model boat to be carried along by high-bred horses at a speed of 17 miles an hour, and made the head pass between two oranges floating on the water, and which he intended to represent two particles of the water to be removed. The oranges merely touched the side of the vessel until they got amidships, and there remained, thus showing that no greater force had been applied to them than was necessary to remove them out of the way of the vessel. Another phenomenon observed was, that, instead of the high wave at the bow, which sailors thought was a sign of a ship sailing well, or what they called carrying a bone in her teeth, the elevation and subsequent depression of the water were entirely got rid of. He at first thought it would be better to have the same shape behind, but he found it did not answer at all. He discovered, in fact, that the fuller she was behind, and the flatter she lay upon the surface of the water the quicker she sailed, and that this should be the case is clear, when it is considered that the water, returning to its level, is governed by an entirely different law from that by which it is first separated. These two considerations united led him to the adoption of what is known as the wave principle. In the wave formation the greatest breadth of the ship is not at the bows, or even amidships, but a great way aft, in the ratio of three to two, and the other peculiarity is, that there is a long aud extremely gentle hollow in the water line forward, with a very full water line abaft, but which is, however, never on the surface of the water to exceed a cycloid.

An interesting discussion followed, and several members expressed themselves highly gratified at the explanation which Mr. Russell had given of his theory.

Professor Willis, the president of the mechanical section, brought forward a recommendation that that section might be reunited to the mathematical and physical section, the whole to be called "The Section on Mathematical, Physical, and Mechanical Science." This arrangement was considered advisable, in consequence of the necessity of the same members attending both in most cases.

The secretaries and officers of the council were then reappoiuted, and Professor Ansted, Professor Willis, and Major Shadwell Clarke requested to act as auditors. This being the last business meeting of the association, the general committee was declared to stand adjourned until the 23rd of June next, at Oxford.

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## Art. VI.—ANALYSIS OF BOOKS.

*Comprehens've Tables, for the Calculations of Earthwork as connected with Railways, &c.* By E. G. Hughes, C.E. *Calculated from* 1 *to* 50. *With an Appendix, by* W. J. Hughes, C.E. *Calculated from* 50 *to* 80.

The Tables now under review are intended to shorten the time taken up in calculating quantities of earthwork, by giving at one view the result required. They are calculated on Dr. Hutton's principle of the prismoidal formula, which is familiar to engineers, but rendered difficult in use by the want of simplicity in the application of its principles. The explanation given of the term in the work before us we will quote, as being the principle on which the tables have been calculated:—

"The prismoidal formula of Dr. Hutton is the most convenient and correct," (*of the several methods devised for ascertaining the cubic contents of cuttings and embankments.*) "The earth to be excavated or embanked is considered as a succession of prismoids, whose ends are the cross sections at the various heights, taken as parallel planes, and whose sides are the formation level, or line of roadway—the slopes—and the natural surface of the ground; all of which, except the last, are plane surfaces, and, by considering this as such, we are enabled to apply the rule for calculating the solid contents of prismoids, thus giving the correct result, without the trouble of calculation, or trusting to the erroneous method so long in use of mean heights and mean areas. There is a novelty in the arrangement of these tables which is a decided improvement in the method of printing them heretofore; they are divested of all superfluous figures, being angular in shape, and giving the result for each base and slope at one view."

*Appendix.*—This portion of the volume, from 51 to 80, giving the result in a tabular form, is calculated on the principle of the prismoidal formula, and is intended to complete (by being carried to 80) all the tables previously published, which have not been calculated beyond 50, such as Macneill's Tables, which are now out of print, and scarce. The value of these tables consists in saving the time required for calculating the quantity given here, which takes up much valuable time without that certainty of correctness which is had in those pages. At the present time when so much is to be done in railway works, to the engineer in the first instance (who requires his estimate of the cost to check the contractor's estimate), and to the contractor, in the next instance, who has but a short time generally allowed him to make his estimate, we recommend this as a work which has been long required. None of the works heretofore published for the "Calculations of Earthwork, of Cuttings, and Embankments," has exceeded 50, and consequently left unfinished for present purposes the quantities required. In the improved state of the engineering profession, where cuttings are frequently made to a depth of 80 feet, Macneill's Tables, so justly celebrated at the time of publcation, do not give now the required information, and are in form and facility of reference, different from the tables now before us, the arrangement of which is a great improvement in this work. We cannot but give praise to the manner in which the book has been got up, the figures being clear, and the divisions easily seen, so that reference may be had to any sum without chance of mistake.

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## Art. VII.—PAPERS FOR REFERENCE.

### *Report of Mr. R. Stephenson to the Directors of the Sambre and Meuse Railway.*

Gentlemen,—Having visited Belgium for the purpose of examining personally some points on which questions had arisen in the execution of the works of the Sambre and Meuse Railway, and also the general features of the country through which it is to pass, I beg to lay before you briefly the result of my examination. I need not refer in detail to the direction of the line, since that has been already reported on by Mr. W. Cubitt and Mr. Sopwith in a very elaborate manner, and more recently by my father, Mr. G. Stephenson. It is therefore only necessary for me to state that I concur with them in their opinions as to the judicious selection of the line, and as to its capability for opening the great mineral district which it is intended to serve. From Charleroi to Walcourt the line has been laid out, detailed contract plans prepared in a most satisfactory manner by M. De Grandvoir, and the contractors are now actively engaged in the execution. From Walcourt to the mineral district near Morialme and Florennes, where the branch lines are to pass, I examined the country with reference to the questions which had arisen as to the position of such branches, and the best mode of approaching the beds of ore. Their direction has been decided on, and the necessary proceedings for carrying the work into execution are in progress. In the district between Walcourt and Couvin, the tunnel near Cerfontaine occurs. This was one of the questions on which my opinion was desired. With the view of finally deciding on the line to be taken at the summit, M. De Grandvoir submitted to me two sections. After duly considering both, I decided on recommending the least expensive one, which he is now proceeding to carry into effect. I examined also the Acoz Valley branch, commencing from near Charleroi, by Chatelet, and thence, leaving the Valley of the Sambre, pursuing the course of the tributary stream towards Gougnies, and thence to another part of the mineral district in the vicinity of Morialme. The works on this branch have not been commenced, and it is not proposed that they should be at present; an extended period is granted for its execution, and it is desirable first to complete the other portions of the line from Charleroi, by Walcourt to Couvin, and the branches from Walcourt to Morialme, which will open out the rich and extensive deposit of mineral. My attention was given to the question of the connexion of this branch with the State line. On this subject I have to observe, that I think it very desirable to make arrangements with the Government for the use of their line up to the point where it is proposed to leave the Valley of the Sambre, or to obtain powers to lay down another line of rails parallel with theirs. This arrangement would certainly be convenient for the various iron furnaces and manufactories with which both lines must communicate, as well as for facilitating the interchange of carriages from one line to the other, which will certainly be required for public accommodation. With reference to the general arrangement of the work, and the laying out of the lines, I think it due to M. De Grandvoir to state that they have been effected with much judgment, and that every question has received the most careful consideration. Since my return from Belgium, I have examined the recent report of M. Magis, the Government engineer, and the elaborate details of traffic which are there brought out have been analyzed under my direction. I entirely concur with M. Magis as to the anticipations of traffic which are there set out. R. Stephenson.

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### *Report of Mr. R. Stephenson to the Directors of the West Flanders Railway.*

Gentlemen,—I regret that it has not been in my power, since I inspected the line and works, to report to you the observations which occurred to me. The first section which occupied my attention extends from Bruges to Courtrai, about 31 miles; and on this I need scarcely make a remark, as the works are of so slight a character, and are progressing so satisfactorily under the superintendence of M. Prisse, that I have no doubt whatever of this portion of your undertaking being completed within a few months, and at the estimated cost. Throughout this section the country is one of the most favourable for the construction of a railway I ever inspected; and from an examination of the traffic upon the existing and neighbouring lines now worked by the Belgian Government, and a comparison of the relative populations, I have no apprehension of your expectations not being fully realized as regards traffic. The next section I examined extends from Courtrai to Ypres. The surveys and sections of this district are not yet completed but from the progress made, and after my personal examination of the country, I am enabled to state that, throughout, the line may be executed with facility and economy. From Courtrai to the vicinity of Werwicq (being upwards of half the whole distance), the surface is as favourable as that between Bruges and Courtrai: the remaining half, however, involves no difficulty or costly work, except a short deep cutting or tunnel near Ypres. From Ypres to Poperinghe the line is almost entirely on the surface. The third section of your undertaking, between Furnes and Deynze, I had not an opportunity of going over in detail, except that portion between Thourout and Thielt. I cannot therefore give a decided opinion upon the engineering works, but, from the information obtained from M. Prisse, I am satisfied that they are of an easy character. This portion of the line cannot fail to make it a very important feature in your West Flanders system of lines. It not only traverses a rich agricultural and well populated district, but, from its direction, must at an early period become one of the most frequented thoroughfares into Belgium from England, by way of Calais and Dunkirk: as I entertain no doubt whatever that a line uniting Calais, Dunkirk and Furnes, will be very shortly undertaken, and, when completed, in conjunction with this part of the West Flanders system, it will form the most direct route between England and Ghent, Antwerp, Brussels, Malines, Liege, and the whole of the east of Belgium, and, consequently, with Cologne and the Rhine. With the view of giving my opinion on the proposed addition to the West Flanders railways of a line from Courtrai to Bossuyt, I examined the country lying between those places, and carefully reflected upon the permanent advantages likely to flow from the construction of this piece of railway. There cannot be a doubt that the construction of this line is the most effectual and prompt mode of establishing an extensive coal trade in West Flanders, and effectually competing with the circuitous river navigation by way of Audenarde and Ghent. It would, in short, be the substitution of 10 or 12 miles of railway for upwards of 160 miles of tedious and uncertain river navigation. Of the result there would be no question; but in considering this subject, it is necessary to weigh the probability of other railways being constructed, which might to some extent not only interfere with, but perhaps entirely supersede, this line for the purposes of coal traffic—this being assumed as the principal aim of its construction. Already the Government line extends from Courtrai to Tournay; and, although a good canal communication between the latter place and the Mons coal-field is in existence, it is obvious that a railway will also be formed from Tournay into the same coal-field, to join the line now in operation between Valenciennes and Mons. In this way, the coal from the Mons coal-field would reach West Flanders by railway without trans-shipment, and would consequently be in direct and injurious competition with the Courtrai and Bossuyt line, which would only obtain its supplies through the medium of the canals and river. In this competition, it is probable that the Bossuyt line might maintain an equality, if not a slight ascendancy, as regards price; yet I am disposed to think it would scarcely be so much as to justify the expenditure which would be called for, especially as I am convinced it would end in a compromise between the two routes, leaving a divided traffic to meet an increased expenditure of capital. This view of the subject may be said to depend merely upon the probability of the construction of a line from Tournay towards Valenciennes, and therefore not entitled to so much weight as to postpone the adoption of a short extension of your system, which would be certain to produce a beneficial effect on the undertaking generally. I have not overlooked this mode of viewing the subject; but when, to the probability of a line being formed in the direction I have described, is added the fact that a line from Tournay, by Ath to Jurbise, is actually now in progress of execution, by which a part of the Mons coal-field will have uninterrupted railway access to West Flanders, through Tournay and Courtrai, I cannot hesitate in recommending the postponement of the line from Courtrai to Bossuyt. To render either of the routes which I have pointed out between Mons and West Flanders efficient, nothing is required by the West Flanders Company but permission to use the line, in common with the Government, between Tournay and Courtrai. Such an arrangement is perfectly practicable; and I would suggest that such proposal should be submitted to the Belgian Government for their consideration, as, I am satisfied, if properly carried out, it could not fail to be mutually beneficial.

R. Stephenson.

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## Art. VIII.—NOVELTIES IN ART AND SCIENCE.

*Smelting of Hot-Blast Iron*—Mr. R. Mushet, in a letter to the *Mining Journal*, states that the best method of constructing hot blast pipes is that which he has adopted. It consists of a spiral tube of cast-iron; each thread of which is composed of two flat elliptical segments of piping, 15 to 30 inches inside measure in width, by 3 or 4 inches in depth. The spiral tube thus formed, by jointing together these segments, consists of as many revolutions as may be deemed sufficient; the more in number the greater being the heating surface, and the less the fuel required to heat the air. The complete tube is enclosed by a cylinder of brick-work, heated like a common flue; the cold air enters at the upper and cooler extremity of the tube, and, after descending along the heated spiral, makes its exit at the lower extremity, where the heat will be at a maximum. Hot-blast pipes thus constructed, and protected by brick-work, will last for an indefinite length of time; they will likewise admit of a maximum amount of heating surface, facility of heating the air, and a minimum of fuel to heat that air. Less friction will likewise be found to take place with such pipes than occurs in pipes constructed by the ordinary methods; whilst a temperature of 1000° may be given to the air, with less danger to the safety and endurance of the pipes, than is at present incurred by them in obtaining a temperature of 500° to 600°. Mr. Mushet says, however, that there is no necessity for employing so expensive a material as cast-iron in the construction of hot blast stoves; he has long contemplated the adoption of a species of cement, which he has tested, to form an imperishable tubing, capable of withstanding a heat which would speedily melt cast-iron, and the success of which is likely to be satisfactory. But it appears to us that such tubing can only be employed beneficially for the last degrees of heat, and that iron pipes must be used for the lower degrees, as they conduct the heat to the air much more rapidly than a pipe of cement would do.

*Collins's Atmospheric Railway.*—In Mr. Collins's system the pipe is laid as usual, but the slit on the top, instead of being continuous, is a series of slits about 25 feet in length, alternating with equal lengths of the pipe unprovided with slits. Over each of these slits a square box is laid, with the mouth upon the top of the pipe, and with its ends closed by means of slide valves. When these valves are closed, the communication between the atmosphere and the interior of the tube is shut off; but when one of them is opened the air will rush into the box, and thence into the tube, which is constantly in connection with it. A square bar, exactly fitting the boxes, and of such a length that part of it will always be in one box at least, is the medium of connection between the piston within the tube and the carriage without the tube. An arm from the piston grasps the square bar during its passage through the box, while a similar arm from the carriage grasps that part of the bar which is clear of the box. The piston advances with the bar to the end of the box, when the piston arm is retracted within the tube, loosing its grasp of the square bar; the carriage arm in like manner is detached from the square bar, and drawn up to avoid striking the end of the box which it is approaching; the square bar being simultaneously grasped anew by other arms attached to the piston and the carriage. The alternate attachment and detachment of the arms is effected by making the ends of the boxes slope both inside and outside, so that when a piston arm, after passing along a slit, comes to the extremity of the box, it is gradually forced downward by the incline until it gets beneath the unslit part of the tube, along which it travels to the next box, where the springs attached to it force it out gradually through the slit as below. In like manner the carriage arm is pressed towards the pipe by springs, passes along the surface of the pipe, rises up the inclined ends of the boxes, along the top of which it runs again to descend and gear with the square rod. To the piston is attached a frame to carry the required arms at the proper distance, and to allow the piston to be sufficiently in advance. The ends of the piston arms fit into notches on the under sides of the square bar, the arms attached to the carriage fitting into similar notches on the upper side of the bar. The sliding valves at the end of the boxes are opened and shut by wedge-like pieces attached to the carriage at proper intervals.

*Submarine Boat.*—Some experiments have been of late made in France with a boat constructed after the plan of Dr. Payen, and called by him *bateau cloche* (bell-ship). It is made of iron, and is to be seen near the Pont Royal, at Paris, where it is now moored. On its last experimental trip, 11 persons were on board, and the craft passed under the water through the space between the Pont Royal and that of La Concorde. None of the passengers manifested the least inconvenience, although there was a sort of telegraph established for communicating with those above water to enable them to make such a sentiment apparent. There is nothing very novel, however, in this feat, for Fulton 40 years ago invented a submarine boat for enabling him to fix his torpedo to the bottom of ships, and he carried with him a vessel of air for the purpose of respiration. There is no doubt that an efficient submarine boat can be made without much difficulty, but it is not very easy to see what useful purpose such a boat could serve.

*Coating Metals with Platinum.*—Mr. George Howell, of Clapham, has recently taken out a patent for coating metals with platinum, by the electrotype process. He first dissolves the platinum in *aqua regia,* which is a mixture of the nitric and muriatic acids. The iridium which remains in the form of a black powder is next to be separated by filtration, and the liquid is to be evaporated to dryness. Caustic potass dissolved in water in equal weight to the platinum employed is next to be poured over the dissolved platinum, which will precipitate it, and oxalic acid is then to be added to the liquid in a boiling state, until the precipitate is completely dissolved. The solution is now ready for coating metals with platinum by the electrotype process, and for which the Daniel or Bunsen battery may be employed. The citric, tartaric, and various other acids, it seems, answers as well for re-dissolving the precipitate as the oxalic, and the patentee does not confine himself to any of them in particular.

*Spontaneous Sounds in Iron and Stones.*—Singularly illustrative of the much disputed property, affirmed by the ancients, of the sound emitted at sunrise by the statue of Memnon, in Lower Egypt, is the singular phenomenon of sound occasioned by the vibration of soft iron produced by a galvanic current. It was first discovered by Mr. Sage, and has been since verified by the observations of a French philosopher, M. Marian. The experiments were made on a bar of iron, which was fixed at the middle in a horizontal position, each half being enclosed in a large glass tube, around which were wound spirals of copper wire. A cord of copper wire was afterwards substituted for the two helices, and placed with its axis coincident with the axis of the bar. On completing the circuit, the longitudinal sound, although feeble, could be distinguished,—the bar of iron being a little lengthened or expanded in the direction of its axis. The origin of the sound has, therefore, been attributed to a vibration in the interior of the iron bar, or a new arrangement of the molecules.

*Arsenic in Paper.*—The French government having lately been informed that several poisonous ingredients were used in the manufacture of various kinds of paper, directed a large quantity to be seized, and instructed Messrs. Payen and Chevallier, the chemists, to analyze the same. These gentlemen, by well executed experiments, detected the presence of arsenic, lead, and copper, which, in their report to the government, it is stated, are present in consequence of the *débris* of coloured papers, scraps of which owe their colour to salts of arsenic and copper, cards called porcelain, and paper coloured with red lead, all entering into the composition of the pulp used for the manufacture of paper. To detect the presence of arsenic, the paper was carbonized by sulphuric acid: the carbonized mass, being mixed with distilled water, was introduced into Marsh's apparatus, and arsenic produced; the presence of copper was recognized by minutely dividing the paper, and, placing it in contact with pure ammonia, the copper is dissolved, and may be obtained on evaporation; the analysis for the detection of lead was more complicated, but equally successful. It is conceived that the quantity of arsenic, copper, and lead contained in the paper submitted to the above experiments, and which was of that description used for wrapping up articles of merchandise, was very minute, still it is equally interesting with regard to *publis hygiene,* as well as to medico-legal researches, that it should be known that these poisonous ingredients do exist in paper in various proportions.

*Nuremburg.*—A correspondent of the *Art Union* says:—"The inauguration of the splendid Louis-canal monument, erected near the University city of Erlangen, took place with great solemnity on the 15th of July. The monument is one of the finest specimens of this description of monumental art, commemmorating one of the greatest and noblest enterprises of the country. This canal—from Kelheim to Bamberg, thus connecting, by the medium of the river Main, the two most important water-roads of the continent, the Danube, and the Rhine—is now completed, and already made use of to a great extent for commercial navigation, but is awaiting the climax of its importance, which will take place when the commerce from the East to the West, from the East Indies to Great Britain, will have re-assumed its ancient way of transit through the centre of Germany. Our celebrated founder Herr Burgsmiet has finally received the model of the Emperor Charles IV., by the ingenious Dresden artist, Haehnel, for the city of Prague, to be cast in bronze. This piece of art will be one of the most splendid monuments existing. The founder will, even in the execution of this colossal figure, be true to his principle of making as little use as possible of the chisel, for the purpose of minutely representing in the cast the original shape of the model, and of preserving the natural colour of the metal. As the artist is working, as it were, for the completion of his reputation, the most splendid result is to be hoped."

*New Monster Engine for Narrow Gauge.*—It is reported that a new narrow gauge engine, far superior to the present narrow gauge locomotive, in speed and power, has just been completed. It is stated to be equal to an average speed of 60 miles per hour, with a train of 12 carriages, of about 66 tons.

*Physical Discovery.* — Hitherto heat unaided by affinity has been unequal to resolving water into its constituents; electricity has been the only single agent by which this could be accomplished. But we hear that Mr. Grove has succeeded in decomposing water by heat alone; or, popularly to express it, he has boiled water into its elements, oxygen and hydrogen. This, then, is the second grand physical discovery in England this year, both of high scientific importance, and both adding to the fame of their respective authors, Faraday and Grove.

FINE ARTS.

*New Picture in the National Gallery.*—The trustees have bought of Mr. Farrer, of Wardour-street, the fine picture by Velasquez, formerly in the royal collection of Spain, and which was presented some years ago by Ferdinand VII. to Lord Cowley—from whom Mr. Farrar purchased it. It was offered, a few years back, by Lord Cowley to the National Gallery,—but the offer was not then accepted. It is a large picture of its class,—being about 9 feet long and 5 feet high, and represents Philip IV. with his grandees assembled at the Prado to enjoy the sport of hunting the wild boar. This picture, it is said, has been very fortunately rescued from exportation to Holland, being actually about to be sent out to the royal gallery of that country, when it was, by a representation made to the proper quarter, not by the owner, but by some of the patrons of art, secured for our own gallery.

*Glasgow School of Design.*—The annual distribution of prizes, awarded at the end of last session, when flattering reference was made to the exertions of the master, Mr. Macmanus, took place on the 17th ult., Mr. Leadbetter in the chair. Mr. Leadbetter, in the course of his address, shewed, as evidence of the importance of design in manufactures, with reference to some articles in metal, particularly stoves and fenders, that while, in the year from September, 1839, to September, 1840, the number of such articles registered was 392, in the following year they had increased to 813: in 1842 to 1306; in 1843 to 9835; by September, 1845, to 21,953; and by January, 1846, to 33,188, whilst a sum had been paid to Government in fees on the above-mentioned class of registered goods of 99,564*l.*

*Roman Remains.*—The Roman station, Burgh Castle, at the confluence of the Yare and the Waveney, near Yarmouth, supposed to be the ancient Garianonum, and constituting one of the most perfect specimens of a Roman fortress now remaining in this country, was lately sold to a Mr. Butcher, of Yarmouth, together with 27 acres of land surrounding its walls, for 1,500*l.* We learn that it has been purchased for Sir John P. Boileau, Bart., the President of the Norfolk and Norwich Archæological Society. The manor house and farm have also passed into the same hands, and it may be hoped that the new proprietor of so interesting a relic, which, in truth, belongs to the public at large more than to any mere private individual into whose hands it may happen to pass, will regard it as an ornament to his property, and, as such, take a pride in its preservation.

*Frescoes in the House of Lords.*—Mr. Dyce has completed his fresco in the House of Lords. It has met the high and unqualified approval of the Commissioners, and they have, in consequence of the success of this experiment, recommended, or rather confirmed their original recommendation, that the remaining compartments in this House should be painted in fresco. The designs of three artists—Messrs. Maclise, Cope, and Horsley—(which have been subjected to many advantageous alterations) are approved; but they cannot commence the works immediately, partly because the period is inconvenient to them, but chiefly because the architect is now hurrying on the completion of the House of Lords, with a view to its occupation next year. The noise and bustle of workmen would be incompatible with the careful execution of the frescoes. A report is in preparation, in which the commendations of the Commissioners are bestowed with due liberality. In truth, the beginning, now actually made, of the decoration of the new Houses of Parliament, by means of painting, is as promising as could be wished.

*The Statue 'Modesty Unveiled.'*—This is the title given to a statue which was sent by Mr. Park, in competition for the premium of 500*l.* lately offered for a group or figure by the Art Union. The statue was not exhibited with the others—a circumstance of which Mr. Park loudly complained, and, we believe, has given publicity to his feelings on the subject. After all, if volumes were written on both sides, there is but one solution to the question, and that is the statue; let us describe it as it is. It is an upright female figure, entirely nude, and very slightly supported by a few folds of the fallen drapery behind. In the first place, for the author of this work it would seem that the ancients have laboured in vain; it is modelled without the slightest effort at idealization—an offensive portraiture of a model—coarse in more than an average degree. Proud are we to find splendid examples of a contrary treatment in our school. Speaking of this statue, the *Art Union* says:—"The lower limbs are massive and ungraceful; the upper part of the figure is exaggerated and sensual; the work could only be tolerated as an Academy study, and then it would be condemned as utterly deficient of every particle of that beauty and elegance which are the great charm of the nude figure; it is, in short, everywhere the flesh without one gleam of the spirit; even the title is injudicious, to use a mild term; and the Committee were perfectly justified in rejecting it. The proprieties of Art have been established more than two thousand years, and they cannot now be outraged with impunity."

*Interesting Discovery.*—Two paintings have just been discovered in Rome, one of which is supposed to be the work of Michael Angelo, and the other of Raffaell—the first represents Christ being laid in the Sepulchre, and the other is a portrait of Cardinal del Monte. On the back of Buonarotti's painting is a tin plate bearing the Farnesi arms.

SUMMARY.

The eminent and ingenious poet-painter Lessing, has just completed a landscape of conspicuous character for Vienna, and the cartoon of his eminently grand creation, 'Huss Kneeling before the Pile previous to Execution.' Everything attempted by this thinking and truly meditative artist is certain of success.—Mr. J. C. Hook has been appointed travelling student by the Royal Academy, and is now on his way to Rome. He obtained, it will be remembered, the gold medal at the last distribution. We rejoice at this young artist's good fortune—if the term may be applied to merit amply earned and deserved. His progress iu Art has been steady towards high excellence; he has exhibited in all his works well-directed thought and industry as well as genius; and we cannot doubt that he is destined to occupy a very foremost rank in his profession, for he is sure to turn his present advantages to valuable account. Mr. Hook is the grandson of the learned Dr. Adam Clarke.—A correspondent at Southampton announces that Mr. Louis Fraser, late Curator of the Zoological Society of London, has just returned to this country with a fine collection of natural history, both living and dead, which has been gathered during the past summer, in the Regency of Tunis; to which placc the traveller repaired, in March last, at the express desire of the Earl of Derby.—The Paris papers mention the death, at Versailles, of the last surviving genealogist of the name of D'Hozier; also the well-known and once popular writer M. de Jouy, a member of the French Academy, and Librarian of the Louvre. His works are many, and various in range:—but as the author of 'Sylla,' and 'The Hermit of the Chaussee d'Antin,' his name is, probably, most familiar to English ears. The same papers give unfavourable accounts of the health of the poet Beranger.—The Saxon government, it is stated, has acceded to the copywright convention recently concluded between England and Prussia.—At Berlin, the 35th Exhibition of the Fine Arts opened on the 1st ult.—The church of St. Eustache, in Paris, has been recently enriched by a work of Art spoken of as remarkable, and at a cost of between 4,000*l.* and 5,000*l.* This is a high altar of white marble erected after the designs, and under the direction of M. Baltard, the architect,—the sculpture details being supplied by M. Bex.—The *Morning Herald* has a paragraph announcing the arrival of a vessel from Leghorn, having on board about thirty valuable paintings by the most eminent old masters, marble statues and ornaments, and other choice articles of virtû—consigned to the Council of the Royal Academy.—The members of the Committee appointed to conduct a subscription for a monument to the memory of the late Mr. Michael Nugent, one of the ablest parliamentary reporters of the newspaper press, have terminated their labours. A tablet in which is inserted a medallion likeness of the deceased, sculptured gratuitously, in marble, by Mr. Carew, and inscribed with a suitable record—has been erected in the Ccmetery, at Kensal Green.—The National Gallery is closed and will remain so till the 26th of October. The East-India Company's Museum, where there is a collection of curiosities well deserving examination, is closed till the 30th ult.—The exhibition of pictures and sculpture, selected by the Art Union of London prizeholders, was visited during the last week by more than 50,000 persons, without the occurrence of the slightest accident or disturbance.—"The establishment of the second Italian Opera," says the *Athenæum*, "has already done good, if all tales be true. It has quickened activity in the 'old house;' which, indeed, *must* bestir itself, or throw up its game as regards music—the *ballet* world not offering too many resources just at present. Rumours are already abroad, of plenipotentiaries, 'bloody with spurring, fiery red with haste,' despatched to the feet of Mdlle. Jenny Lind. We shall possibly have Pischek, too, for two months' service as *baritone.* Let us suggest fillings up:—Duprez for a few nights as tenor, in case a certain Signor Fraschini at Vienna—well spoken of—prove unattainable or a bad singer; and for *contralto* Madame Viardot—to whom no one can object on the score of unloveliness, present engagements being considered. Further, Madame Dorus-Gras, if we mistake not, is still to let. What a whimsical state of affairs, when it is 'upon the cards'—nay, seems to us the only promising extrication from a position full of difficulty—that we should have an Italian Opera without a single Italian singer! In any case, good can but come from the opposition."—The *New York Herald* mentions that Lieut. Maury is engaged, by instructions from the American Government, in the construction of a Nautical Almanac. "The two most celebrated European catalogues of the stars," that paper adds, "'Bessel's Zone Observations,' and 'Struve's Catalogue of Double Stars,' extend only to 15° south of the equator. The Washington Observatory, from its geographical position, can command a zone of 15° farther south,—thus embracing a space of the heavens not within the ken of European observatories. Lieut. Maury will have an opportunity of adding to the catalogue all the stars within this space which he may observe." The Government is recommended to give to this useful undertaking its largest developement, by "ordering the manufacture of a telescope equal to that of Lord Rosse": but telescopes like Lord Rosse's are ordered much more easily than made.—The Paris papers, about a month ago, recorded a suicide of a man then unknown. It has since been ascertained to be Kaufman, a poet of distinction in Berlin, the translator into his native tongue of the plays of Shakspeare and the poems of Burns.

CONSTRUCTION.

*Statue to Quentin Matsys.*—A correspondent of the *Athenæum* writes as follows:—"The good old town of Louvain is just now all a-gog with the erection of a statue to Quentin Matsys. For ages the Antwerpians, ever contentious for the honour of giving birth to noble painters, had the credit of the nativity anong them of this great ornament of the early Flemish school. But at length it was discovered, and placed beyond doubt, that in this particular case Antwerp must cede the honour to Louvain. In consequence, a committee has been formed, and subscriptions are coming in, to celebrate in fitting style the fact that Louvain is the mother of Matsys. His statue is to be erected there in a conspicuous situation; and no doubt the ceremony of inauguration will be splendid,—as was that of the installation of the statue of Rubens in the place Verte, at Antwerp. It is something singular and pleasing in that very enlightened and prosperous country, Belgium, that all ranks and classes of the people have the mind to honour the great works of art and literature. From the noblesse to the drivers of the Vigilantes, all have a word of unfeigned admiration for these bright evidences and effluences of the soul. When will the like obtain in wealthy England?"

*Dwellings for the Poor.*—A correspondent of the *Mechanics' Magazine* offers the following suggestion:—"As a substitute for the late wretched habitations of the poor in the neighbourhood of St. Giles's and elsewhere, might not dwellings be erected on a plan somewhat similar to many of the 'olden time,' with galleries, and resembling in some measure the caravanseries of the East. Some of the advantages of such structures would be, the small area of ground comparatively that would suffice, the cheapness of erection in reference to each tenement, the good ventilation that would result, as well as the conveniences for cleanliness and general comfort. Furthermore, the scheme would offer a good return for investment, at a rental as low as that paid by the inmates of the late abodes of filth, privation, and disease. We will suppose a street of rather more than 300 feet long, and about 50 broad. Let this be divided into 25 distinct compartments (one on each side of the street), each having two rooms, besides a small one containing the sink, water-pipe, and privy, and having as a sanatory measure, ceilings of an altitude of 9 or 10 feet. These would supply residence for 25 poor small families on the ground floor. Upon these let two or three more stories be raised, with corresponding compartments, and access be afforded by continuous galleries or arcades. Two hundred dwellings, clean, cheap, comfortable, and airy, would thus be provided in a comparatively small space, possessing but one inconvenience,—that of ascent, which use would diminish, and which the inhabitants of Edinburgh and Paris never, I believe, complain of. Connected with the street might be added an accommodation for the collective benefit—a general wash-house; and that supported by a small fraction of additional rent on the 200 tenements. The water might be contracted for on advantageous terms, in consequence of the concentration of the supply. According to the best calculation I can make, a weekly rental of 2*s.* for each compartment of two small rooms, and an additional small one with conveniences, would allow a liberal return on the capital required; especially if the Commissioners of Woods and Forests would, as in duty bound, provide the ground on reasonable terms."

*Interesting Discovery.*—In excavations recently made on the domain of Harbourg, in Bavaria,—belonging to Prince d'Oettinger-Wallenstein, the workmen employed in making them came suddenly on the basement of a large Roman villa: and, at a small distance from the spot, discovered the ruins of baths, the rooms of which were ornamented with fresco painrings in good preservation. Under the pavement and in the walls were pipes for the circulation of warm air,—similar to those discovered in other Roman ruins in Germany. The prince has given orders for laying bare these remains, and for continuing the excavations in all directions.

*The New Parks in Manchester.*—The three new parks just opened have cost, it seems, about 35,000*l.* Three composition statues have been contributed by Mr. Armitage, of Sheffield, and placed in appropriate situations. The grounds are all well tile-drained, and provided with fixed and moveable seats, side walks, gymnasia, archery butts, play grounds, May poles, &c. —and, what are still more wanted in our metropolitan parks, drinking wells and other conveniences. They are well laid out with trees, shrubs, plants, &c., and have been declared to belong exclusively to the working classes—although the authorities have not failed to supply them all with well-appointed carriage drives. Elsewhere, we see it stated that property, which it is conjectured may yield little less than 100,000*l* has been recently bequeathed to found a University in Manchester. To this sum it is expected that as much more will be added by contribution: and in a few years, it is said, Manchester may possess a University which, while not inferior to any existing establishment in the means of general education, will at once take, as regards practical science, an unrivalled position.

Cork and Bandon Railway.—There are a very large number of men at work on Mr. Parratt's two contracts at the Bandon end. The piers of the bridge across the Bandon river and mail coach-road at Doundaniel are nearly at their height. Mr. Bolton's contract, near Crossbarry, is also proceeding fast. The men are employed on this part night and day.

SUMMARY.

The inhabitants have petitioned for leave to remove, at their own expense, the colonnade in the Quadrant.—The whole scheme for the formation of new markets at Hull has fallen to the ground, in consequence of the adverse votes of the majority of the town council.—A national school is to be erected at Fleetwood, as a testimonial to Sir Hesketh Fleetwood, the "Father of the Town."—The Health Committee at Liverpool have been instructed to consider the requisite number, and the most eligible sites for the erection of additional fresh-water baths and wash-houses there. In the establishment at Frederick-street, while the number of baths for the quarter ending August 27th, 1845, was 6,116; in the corresponding period of 1846, it was 3,481. The receipts for the baths and wash-houses were, for for the same period in 1845, 131*l.* 4*s.*, and in 1846, 145*l.* 2*s.* 5*d.*, so that the establishments are in a decidedly thriving state.—A marble monument to Miss Linwood, the celebrated needlewoman, has been executed by Mr. S. Hall, and placed in St. Margaret's church, Leicester. The inscription commemmorates her needle-works as "Monuments of Art and Perseverance."—The clearing of the site for the erection of the new markets in Doncaster is in progress. The new shambles and various other buildings have been demolished, and the materials sold, except the bricks, in lots, and at high prices. A new cemetery is in contemplation at Doncaster. A company, with shares of 20*l.* each, is about to be established.—A movement has commenced in Edinburgh and its surrounding agricultural district for the enlargement of the old corn-market, or the establishment of a new one. A committee of farmers, corn-merchants, and others, has been appointed as the representative of parties locally interested.—The royal pavilion at Brighton was to be closed on the 5th ult.—The Bishop of Salisbury re-opened the parish church of Tilshead on the 15th ult., its extensive repair, restoration, and enlargement being completed.—The ancient church of Chelmsford is at length, it is to be hoped, in the way of restoration or repair. Mr. Rayner, the builder, in making some slight repairs of late, discovered that the roof was so insecure as to require the erection of a number of props in the interior, which has now as ruinous an aspect as the exterior and steeple, the insecurity of which has been so long apparent. An inspection has been instituted by the Bishop of Rochester; and surely a parish which has managed of late to erect no less than two new places of worship will not suffer its old and venerated establishment to fall into total decay.—The architects appointed for the church about to be erected at Two-mile-hill, St. George's, Gloucestershire, are Messrs. Hicks and Gabriel.—The contract for taking down and rebuilding the parish church of Runcorn has been taken at 6,500*l.* The work will be begun when the National School is fitted up for the temporary accommodation of the congregation.—The excavation for St. Paul's church, Prince's-park, Liverpool, was lately commenced, and the first stone is by this time laid. It is to be erected of stone, in the pointed Gothic style, and cruciform, with a spire 150 feet high, and accommodation for 1,560 persons, a number of sittings being free, and at very low rents. The design was furnished by Mr. Arthur Holme, and Messrs. Samuel and James Holme are to be the builders. This is the church of which the Rev. Hugh M'Neile is to be minister.—The stonemasons at Liverpool have resolved, at a meeting held a few weeks since, to form a Co-operative Building Society, in order to secure employment to its members when unable to obtain it elsewhere; and they have pledged themselves to use every exertion until all the masons in England are members of their association.—A correspondent of the *Builder* asks if any calculations have been made as to the probable effect likely to be produced by a heavy gale of wind, either from the south-west or the north-east, on the Menai tunnel? "We have," says that paper, "had ample proof of its destructive character upon suspension bridges similarly exposed, presenting, comparatively speaking, a small surface to the action of that powerful, and, at times, irresistible element; whereas this tubular bridge is to be 450 feet long, 30 feet high, and 15 feet wide,—offering 13,500 square feet of rigid surface (exclusive of the width underneath the roadway) to its resistance. With every confidence in the genius, capacity, and talent of the eminent man who designed the tubular bridge, further and more satisfactory information would be exceedingly interesting to the profession,—and, I have no doubt, to the public at large."—Count Sternberg, the celebrated German geologist, has ordered in his last will that his body shall be inclosed in the hollowed-out trunk of one of those gigantic antediluvian palm-trees, which have assumed the hardness of the most compact sandstone. We are not aware whether his desire has been already carried into effect.—The Rev. E. Dukes, F.S.A., has published a volume to elucidate the Druidical temples of Abury and Stonehenge.—The appearance presented by the paved way laid down in Fleet-street, the execution of which has annoyed all London for some weeks past, is far from satisfactory. The surface is irregular, here and there convex instead of concave, and indeed, appears in parts to have sunk considerably.—Great progress is making at the Waterworks, Green-lane, Liverpool, to render the pipes laid down within the limit of the proposed dock extension at Wapping, serviceable in the event of fire. Mr. Stewart's account for surveying and buying land for the works is pronounced to be exceedingly reasonable.

RAILWAYS.

*A Railway Smoking Saloon.*—Within the last few days, a novelty has been introduced on the Eastern Counties railway in the running of a very handsome carriage, termed a smoking or excursion saloon, which from its elegant and peculiar construction, has excited much interest. In size and form of build it much resembles the royal carriages on the Great Western, South-Western, and other railways. The peculiarity of a portion of the Cambridge and Newmarket traffic suggested to the company the formation of such a description of carriage, and which certainly reflects great credit on the skill of its manufacturer. Its extreme length is 40 feet, the body about 30 feet, the ends being converted into a kind of open lounge. It runs on six wheels, which are fitted with Adams' patent bow springs. The internal decorations are of the most *recherché* description. The seats extend the full length of the sides, and are handsomely covered with morocco leather. A highly polished mahogany table occupies the centre, the entire fitted with self-balancing lamps. The sides are lighted by eight plate-glass windows of unusual size, while the ends are fitted up with four plates of looking-glass. Its drapery is composed of bright crimson silk formed in very graceful design. The roof presents an exceedingly chaste appearance. The groundwork is painted white, the mouldings being gilt. The general furniture is of richly carved polished mahogany. The exterior is painted a deep marone colour, ornamented with gold etchings, and emblazoned with the company's ciphers. It was manufactured by Mr. Adams, the company's carriage builder, at Fairfield Works, Bow. It was launched on Friday, the 4th ult. when Mr. Hudson, M.P., and a large party of the directors and friends proceeded in it to Ipswich, to a grand entertainment at the seat of Mr. Bagshawe, the late member for Harwich. Its easy movement was a subject of much praise. Several others in the same style are in a forward state for the company. They will be attached to all the fast trains to and from Cambridge,—passengers using them paying first class fare.

*A New Railway Signal.*—A new railway signal, invented by Mr. J. H. Dutton, and intended to afford a certain and speedy mode of communication between the guard and driver of a train, has been lately tried on the Eastern Counties Railway, during a trip made especially to exhibit the same from London to Romford. The contrivance is simple enough, and consists of a small copper tube, about one inch in diameter, attached to the bottom of the engine and each carriage in the train. On the engine, and on each carriage where a guard is seated, an upright tube communicates with the longitudinal one beneath. This tube is supplied with a small brass whitle and mouth-piece. A train consisting of 12 carriages would probably have two guards, one stationed on the last carriage, and one about the middle of the train. The guard on the last carriage wishes to bring the train to a sudden stand: for this purpose he blows through the mouth-piece attached to his upright tube, taking care, at the same time, by raising a small brass lever, to render quiescent the action of his own whistle. The attention of the driver and second guard is immediately arrested by the sound of the whistles attached to their respective tubes, the steam is shut off, the breaks applied, and the train stopped. The chief advantage which Mr. Dutton's invention appears to possess over others of a somewhat similar nature which have preceded it, is the placing of the whistle at the extremity of the tube, instead of near the mouth-piece through which the air enters. The trial was with a train of 12 carriages, and we believe the experiment was considered, so far as it went, perfectly satisfactory. The break between the carriages is supplied by an elastic wire and India rubber tube, which is fitted and detached with great facility. The expense of the signal, Mr. Dutton states, will not exceed 30*s*. per carriage.

*Liability of Engineers, &c, of Railway Companies.*—Amongst the lately established law precedents affecting the liabilities of parties concerned in railway proceedings, are the following:—An engineer or other officer of a company may, by his conduct, render himself personally liable to creditors of the promoters of a scheme, though the mere circumstance of his holding office in the company cannot render him responsible. On the other hand, as we have already instanced in one case lately reported, no engineer or other officer has power to bind a company by virtue of his office alone, though such a power may be expressly conferred on him. A director or promoter of a scheme may recover a proportionate contribution from each of the whole number of his associates for what he might have been called upon to pay; solvent directors not being liable at law, however, for insolvent; though, in equity, no regard is had to the original number of promoters, but only to the solvent members. All the promoters must sue and be sued for any breach of contract entered into by them with engineers, allottees, or others, so that it will generally be difficult to maintain proceedings on such contracts in a scheme which has no charter or act of parliament. Hence indiscretion in entering into such contracts by the general name of office, such as "Committee," "Directors," &c. Contracts in such cases ought to be made with a certain small number of persons as trustees. Other well established principles affecting allottees and scripholders, will have been already inferred from our occasional reports of cases.

SUMMARY.

The *Commerce* states, that the unlucky viaduct of Barentin, on the Rouen and Havre Railroad, has nearly been levelled with the ground in consequence of an adjoining house having taken fire, the flames having communicated to the beams which support the arches of the viaduct.—The Glasgow, Kilmarnock, and Ardrossan Railway Company have recently purchased the Ardrossan Harbour and Railway from the Earl of Eglintoun and other proprietors, for 208,000*l*.—Amongst the railway bills which have passed the ordeal of committee is one which, for tunnelling, as observed by a contemporary, one would think had been planned by Pluto himself. It is the Manchester, Buxton, Matlock, and Midland Junction Railway. The length of the line is forty-two and a half miles, or, with its two branches, forty-five. It has fifteen tunnels, one of which is two and a half miles long, and their aggregate length six and a half miles, so that passengers will perform one-seventh part of their journey under ground. The estimated cost is, 1,650,000*l*., or 36,000*l*. per mile.—The new Pope has privileged an Anglo-Roman Company to intersect the Roman States with railways—a curious and interesting episode to the benefits reciprocally conferred by the Romans of old, in intersecting our own country with roads and aqueducts. A condition imposed by his holiness is the realization of a guaranteed fund of about 7,000,000*l*. sterling, a capital which is expected to be raised.—A Bill, it is said, has been introduced in the senate of the United States, to authorise the truly "go-ahead" project of a railway across the Rocky Mountains to Oregon!—Mr. Strutt, member for Derby, is said to be the destined chief commissioner of the new Railway Board.—From the parliamentary return of railway accidents lately called for in the House of Commons, it appears that during the half year ending 30th June, the number of accidents was 116; of killed 73; of injured 84. Of these casualties 15 accidents (the greatest number) occurred on the Eastern Counties line, where forty-one persons were injured and four killed. Next follows the South-Eastern, ten accidents, in which eight persons were killed and seven injured. On the London and Birmingham only four accidents, in one of which no injury resulted; and on the Great Western and the York and North Midland only one accident each, in the former of which three persons were injured and one killed, and in the latter one killed.—A superior newly formed narrow gauge engine is said to be able to average a speed of sixty miles an hour with a train of twelve carriages, or about 66 tons.—The inhabitants of Doncaster have unanimously resolved to memorialise the directors of the Great Northern Railway to establish the plant of the contracts for the high level bridge across the Tyne and viaducts is 304,500*l*. Messrs. Hawks, Crawshay, and Co.'s contract for the iron-work amounts to 112,000*l*. of this sum. Messrs. Losh, Wilson, and Bell, and Messrs. Abbot and Co., it is understood, will take part with the contractors in the execution of their work.—A meeting of the shareholders of the West London Railway was held on the 2nd ult., to receive the report of arbitrators, appointed to decide the rate at which the rent to be paid by the London and Birmingham Company shall be apportioned to the different classes of shareholders. Considerable displeasure was expressed on account of the Birmingham Company not having opened the line for passenger traffic. The inhabitants of Kensington, Hammersmith, Bayswater, and other large districts, are forced unnecessarily to travel to Euston-square and Paddington with locked-up stations at their own doors.—The Dowlais Iron Works employ about 6,000 people, amongst whom are 1,000 miners, and 700 colliers,—the former earning from 21*s*. to 25*s*., the latter 18*s*. to 20*s*. a week. At the works there are 18 furnaces in blast.—The tesselated and asphalte pavement in the centre of the Royal Exchange is now removed, the Turkish stone that formed the pavement of the old building having been substituted for it.—Westminster Bridge is "broken down," according to the old song, which referred to one of its former neighbours, and is in rapid process of demolition.—Operations on the fourth contract of the Midland Great Western have been commenced at Saunder's Bridge, near Mullingar, by the sinking of a second bridge in close connection with the former. The work is a good deal retarded in consequence of incomplete arrangements with the occupiers through whose grounds the line is to pass. Up to the present time, the greatest number of labourers employed has not exceeded 40. The wages are fixed at 12*s*. per week for first-class labourers, and 9*s*. for the second-class.—The operations of the Newcastle and Berwick line have lately made marked progress. With the energy and perseverance usually shown by the contractors for Mr. Hudson's lines, embankments have been formed, cuttings made, bridges built, and the permanent rails for miles laid down. From the advanced state of the works, it is confidently anticipated that the portion of the line between Tweedmouth and Alnwick, a distance of about 30 miles, or half the line, will be opened at the end of October, and that the whole line, with the exception of the bridges over the Tweed and the Tyne, will be completed in February next. An embankment is being made on the west side of Tweedmouth, which will occupy some considerable time in its formation. Of the bridge intended to cross the turnpike road at the High Toll-gate of Tweedmouth, the abutments only are built.

ENGINEERING.

Falling of an Embankment.—The *Bury and Suffolk Herald* relates that on the Ipswich and Bury line of railway for many weeks past the efforts of the contractor and labourers employed at Stowmarket, have been completely baffled by the rapid subsidence of the embankment at that place, and the continued absorption of the earth thrown down since the occurrence. The line is intended to pass on the north-east side of the town, along the valley of the Gipping. A great part of this valley is a substratum of boggy land, covered with a hard crust or surface. Three months since, the road on the Ipswich side was advanced on an embankment ten feet high along a portion of this marsh, and the slight subsidence that necessarily resulted from the immense pressure of earth was expected by the contractor. But in the progress of the work, it was remarked that, with the increase of material, there was a progressive increase in the settlement of the line; still it was not sufficient to excite any apprehensions as to the treacherous character of the bog. On Whit-Monday, however, as we understood, the labourers, upon going to work, were astonished to find several yards of the embankment had almost disappeared, and that, from surrounding appearances, there was a probability of their vanishing altogether. Affairs thus assuming a serious aspect, more "strength" was laid on to repair the accident, but the crust of the marsh having been forced through, the more earth pitched, the faster it was absorbed. The embankment continued to recede gradually for about nine weeks, when a length of 40 yards, with the rails and sleepers, went done one Saturday night. Mr. Douglas, the contractor, determining to overcome the obstacle, persevered in throwing down materials, and by the end of the week, succeeded in re-forming a few feet of the embankment. On the following Monday, all traces of the work were gone, and the efforts of the next week were attended with similar results. Since Whit-Monday, when the first serious subsidence occurred, more than 100 yards of the embankment have been lost, although on the daily average, 120 loads of material have been discharged. As each load contains about 3 cubic yards, it appears, that in addition to the original embankment, there has been absorbed the enormous quantity of 25,000 cubic yards. Directly in front of the heading of the present embankment, the water stands 14 feet deep; over other parts of the sunken line it is much deeper. We were assured that if iron rods, 50 feet in length, had been thrust down, they would not have reached a solid bottom. About half a mile along the valley, the line recommences towards Bury with an eight feet embankment. A disaster similar to the above-mentioned befell this embankment on Sunday week, when about 80 yards were found to be sinking. Men and horses were immediately put in requisition to save the rails, but such was the rapidity with which the subsidence occurred, that a great many rails were lost. At the end of the week, on Saturday last, the work had only re-advanced about a foot, although 2,000 cubic yards of earth had been "dipped" in the interval. The pressure arising from the sunken mass at both places has had a most singular effect upon the adjacent land, which, for 30 or 40 yards in width, it has lifted 7 feet, and broken up, as if a miniature earthquake had happened. It is feared that the space between the embankments is entirely of this marshy nature, as some piles, 45 feet in length, that were driven in midway, for the purpose of erecting a bridge, yielded from 12 to 18 inches at each stroke of the "monkey," and have now disappeared altogether. This is the only portion of the line that has offered any unexpected difficulty; yet, however discouraging it may be, Mr. Douglas still hopes to remove it, so as to be ready to open at the time specified.

*Lowestoft Harbour, &c.—Pile Driving.*—There are two piers proposed to be carried out a considerable way into the sea, and to meet each other at a distance of 150 feet apart, so as to enclose an area of about 20 acres for the harbour. The north pier has been extended 730 feet into the sea, and having been stretched as far as it is intended to carry it in a direct line, it will now take a turn on the south side, so as to make 1,150 feet in all. The pier on the south side is also rapidly extending, but it is not proposed to be so long as the one on the north side. The newly-invented pile-driving machine, called the "knocker," consists of a stage and four pile-drivers, which are suspended at the extremity of the works already completed, and are thus able to pitch the piles, and to run them home to the requisite depth on the bed of the beach. This scaffolding runs upon a tramway, and as soon as one row of piles is completed, it goes forward to lay the next, without the least obstruction. Four solid logs of wood, about 60 feet long, and from 15 to 16 inches square, are laid hold of as they are floating in the water, poised in their respective positions, and then with a power and an ease which astound the beholders, simultaneously driven home from 20 to 30 feet into the soil. The piles are not in the shape of a wedge, but a new kind of a shoe of a conical shape has been introduced, which has been found to be a great improvement. They are all prepared against "the rot," by being placed in a large cylinder, about 80 feet long and 5 feet in diameter, which is then hermetically sealed, and the air exhausted. Under this cylinder is a large tank, containing a quantity of creosote, which is a distillation of tar. When the air has been exhausted, the creosote is forced through pipes by means of a steam-engine, into the cylinder, and the wood is thus thoroughly impregnated and permeated with the liquor.

MISCELLANEA.

A method of expelling carbonic acid gas from pits, mines, and reservoirs, has lately been projected in France, by Mons. Faucille. It consists in discharging among the gas a volume of steam, whereby the gas is in part expelled and in part absorbed, by the water brought into minute subdivision while the steam is being condensed.—Along the Yorkshire and other railways, flocks of health-seekers are flying in all directions towards the watering places. From cheapness of travelling and other facilities this sort of traffic is every season on the increase.—The gas works at St. Neot's have been erected under the superintendance of Mr. Thomas Atkins, gas engineer, of Oxford, in the short space of eleven weeks.—The name Martinsite, (in honour of Captain Martin, of Halle,) has been given to a saline mineral from the salines of Stassfurth, composed essentially of 9·02 parts of sulphate of magnesia, and 90·98 of chloride of sodium. This corresponds to 10 parts by weight of common salt to one of sulphate of magnesia.—In South America there is much talk of a silver mine lately discovered by a watchmaker at Corocoro, in Bolivia. Its ore is said to contain an unusually large proportion of silver, and it is anticipated that this mine will surpass in value the far-famed ones of Potosi.—We understand that the curious collection of English pottery belonging to Mr. Enoch Wood, which was exhibited by Mr. H. Cole at a late meeting of the Archæological Society, has been recently brought to Lord Morpeth's attention, by the same gentleman, as an object worthy of national purchase for the Museum of Economic Geology,—and that the Treasury, at the suggestion of Lord Morpeth and Sir Henry De la Beche, the Curator of the Museum, has sanctioned the purchase. The portions exhibited were but a small part of the whole collection, which exemplifies the entire history of Staffordshire earthenware.—An association under the name of the Aberdeen Literary Society, has just been formed in the Mechanics' Buildings. It is composed of a number of young men who meet together for the purpose of mutual instruction in the various branches of science and useful knowledge, chiefly by means of essays and discussions. It is open to all classes, and has been formed upon the most extended basis, embracing every subject that is likely to be of interest or profit.—Within the last few weeks, property which it is conjectured may yield less than 100,000*l.* has been bequeathed to found a University at Manchester. To this sum it is expected another 100,000*l.* will be added by public contribution.—The Great Western's "Great Western," monster engine, nicknamed by its stokers and drivers "The Russian," from its consumption of oil and tallow, and by the plate-layers "The Mangle," from its influence on the rails, has been already docked for general repair at an estimated cost of 500*l.* to 600*l.*—a considerable per centage on the 9,000 miles it may have run.—On an estimate, or average, 200,000 labourers will be required on railways for years to come.—The gentleman selected by the managers of St. Clement Danes to erect their almshouses, is Mr. Hesketh, the architect, late a pupil of Mr. Hardwick.—The Swiss papers mention that a large portion of the slope of the hill of Thun, near the village of Kandergrien, slid into the lake of the same name, and was swallowed up, on the 29th of July;—the land-slip being exactly coincident with the shocks of earthquake felt in the environs of Cologne and along the bank of the Rhine.—At Hanover, the well-known bookseller Herr Hann celebrated, some days ago, the fiftieth anniversary of the establishment of his house. The King sent to him, on the occasion, the insignia of the Guelphic order; this being, it is stated, the first instance in which the dignity has been conferred on one not noble, in Germany. On the same day, Herr Hahn presented to the Royal University of Athens a selection of books amounting to 2,000 volumes.—The Edinburgh Gas Company are erecting a monster chimney at the North Back of Canongate which will almost rival the St. Rollox stalk at Glasgow. The chimney is nearly completed, being of the enormous height of 310, and 10 feet more, consisting of ornamental work, is yet to be added—the whole being supported by a substantial pedestal of masonry 65 in height. The Annual General Meeting of the members of the College of Chemists was held on the 1st ult. in the Institution, Hanover Square—Mr. Cabbel presiding, in the absence of the Earl of Clarendon. The report stated, with regard to the laboratory, that the total cost of the building will exceed the original estimate—amounting to 5,000*l.* Mr. Blakemore, the member for Wilts, had offered to supply 500*l.* on fifteen other gentlemen subscribing 100*l.* each; and by this means, the sum of 2,000*l.* had been raised, under the denomination of the Blakemore Fund—being distinct from the general building fund. The laboratory department will, it was said, be fully opened in October next. The Report added, that, through the instrumentality of His Royal Highness Prince Albert, negotiations had been concluded with the Prussian government, by which, in the event of the college not succeeding, Herr Hoffman will be permitted to continue his professorship at Bonn. The meeting, afterwards, proceeded to the election of its office-bearers;—when His Royal Higness Prince Albert was re-elected President.—At an elevation of one thousand feet in the Welsh mountains, is situated Bala lake; from it descends, on an average, through Llangollen bridge, one thousand million gallons a day, of the purest and most desirable water in the world. Of this eternal flood, Mr. Rawlinson proposes to convey about 30,000,000 gallons a day, from Liverpool, without pump, engine, aqueduct, or turncock.

# THE ARTIZAN.

No. XXIII. —New Series.—NOVEMBER 1st, 1846.

## Art. I.—EXPERIMENTS ON THE CENTRIFUGAL PUMP BY MR. JAMES WHITELAW.

It will be found that most of the formulæ we gave for Barker's Mill will, if they be slightly modified, apply also to the centrifugal pump. Thus, equation D, or

$$V = 7·853984 \left[ h + \left(\frac{v}{8.0458}\right)^2 \right]^{\frac{1}{2}}$$

will, if $+ h$ be changed into $- h$, apply to the centrifugal pump. That is,

$V = 7·853984 \left[ -h + \left(\frac{v}{8·0458}\right)^2 \right]^{\frac{1}{2}}$ = *the velocity of the water issuing from the discharging orifices of the pump in feet per second* . . . . . . 1

As the series of four experiments described in our last article on this subject was made with a pump of 2 ft. diameter, and as 30 seconds is the time each experiment lasted, it can readily be made out that $\left(\frac{v}{8.0458}\right)^2 = \overline{·02603r}^2$ and as the experiments referred to, were made with a fall of 8 ft., we, by substituting 8 for $h$ and $\overline{·02603r}^2$ for $\left(\frac{v}{8·0458}\right)^2$ in equation 1, get

$V = 7·853984 \left(\overline{·02603r}^2 - 8\right)^{\frac{1}{2}}$ . . . . . . . . . . . . . . . 2

One of the two discharging orifices of the pump was closed up, and the other was left open, when the four experiments were performed. The orifice which was not closed up, allowed a jet of abont ·0024 square foot area to issue from it. Multiplying equation 2 by ·0024 square foot (area of jet) by 30 seconds (the time each experiment lasted), and by 62·3 lbs. (the weight of a cubic foot of water) we get $35·22983 \left(\overline{·02603r}^2 - 8\right)^{\frac{1}{2}}$ = *the weight of water in pounds expended in* 30 *seconds.* . . . . . . . . . . . 3

By this equation the second column of the following table was calculated, the number of revolutions being the same as in the table containing the results of the series of four experiments, given in our last

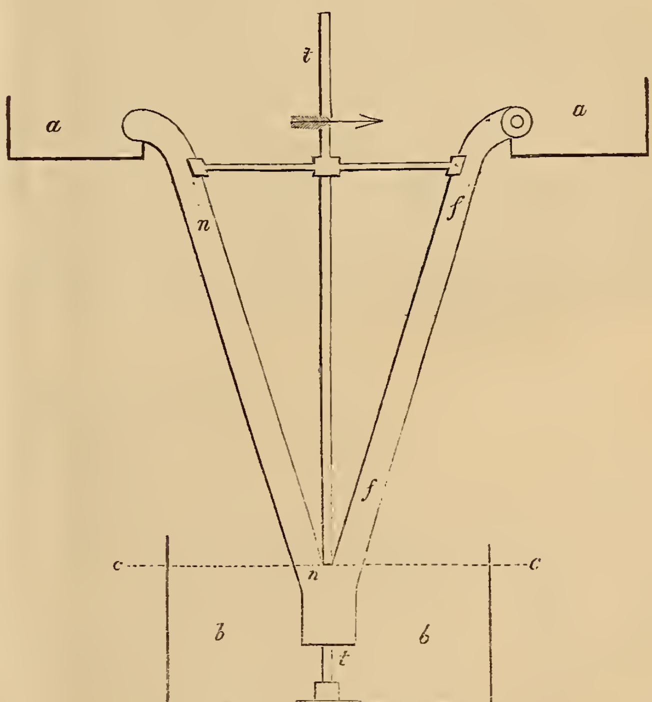
TABLE.

| Revolutions of pump in 30 seconds. | Pounds of water raised in 30 seconds. |
|---|---|
| 159·21 | 106·72 |
| 192·15 | 145·34 |
| 214·11 | 169·19 |
| 170·19 | 120·13 |

By comparing this table with the other referred to, we are led to the conclusion that formulæ 1, 2, and 3 are correct, and we are also led to believe that the quantity of water discharged in a given time will be the same, whether the arms of the pump be made to revolve in the same direction as that in which the jets issue, or in the contrary direction to that of the issuing water. An experiment made with the jet-piece set so that the water was made to issue downwards, shewed that in this case also the quantity of water discharged in a given time is the same as it would be if the jets issued in either of the two directions above spoken of. The fourth experiment gave a less quantity of water than the calculated result, but this is explained by the fact that the water, on account of its being discharged in the same direction as that in which the arms revolved, was dashed with great force against the sides of the box intended to receive it, and thus some of the water lifted was lost by being thrown over the top of the box. When the pump was made to revolve in the contrary direction to that last spoken of, the water fell, or dropped quietly into the box; but when the jet-piece was placed so as to cause the water to issue downwards, the splashing of the water was very great, although not to the same extent as it was when the fourth experiment was made. Some improved forms of the centrifugal pump will next be described.

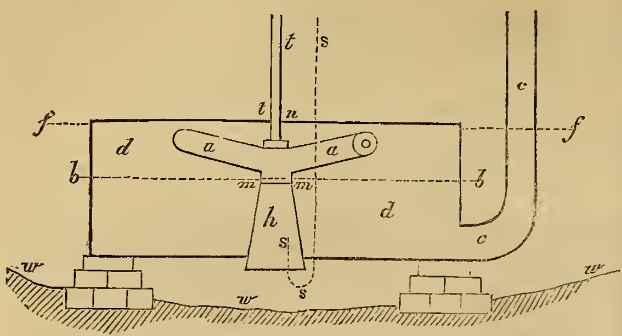
Fig. 7 shews a kind of centrifugal pump, that will fang or fill itself with water. $b$, $b$, is an end view of the canal for conducting the water to the pump, and $a$, $a$ is the box which receives the water lifted by the pump.

Fig. 7.




The pump has two arms; one is marked $n$, $n$, the other $f$, $f$, and $t$, $t$ is the spindle or axis the pump is worked by. In the fig. a step or bottom bearing for the spindle is shewn, and the top of the spindle will be supported by a plumber-block, in the ordinary way. $c$, $c$ represents the surface of the water in the canal, $b$, $b$, and the arrow shews the direction in which the spindle and pump should revolve. If the pump be set in rapid motion, the centrifugal force will carry the water up the inclined arms, $n$, $n$, and $f$, $f$, and thus the pump will not require to be filled with water previous to starting. It may be as well to remark, that each horizontal section of that part of the pump which is in the water in the canal, $b$, $b$, should have a circular outline, for the purpose of allowing the pump to work without being retarded by the water in that canal; and it may further be stated, that the surface of the water, at the time of starting the pump, should be somewhat higher than the line, $c$, $c$, though this generally will happen; yet, as there are cases in which it will not, we have thought proper to direct attention to this part of the subject. If, at the bottom end, the arms of the pump were made to diverge more rapidly from each other than they are represented in fig. 7, the speed necessary to cause the pump to fill with water would not be so great as that required to fill a pump of the form represented, even if the distance from the top of the one arm to the top of the other were the same in both cases.

Fig. 8.




The centrifugal pump represented by fig. 8, works inside of an air-tight casing, *d, d,* and the water delivered into that casing by the pump is carried away by the pump, *c, c.* The casin, *d, d,* and the pipe, *c, c,* are represented in section, and external views of the other parts are given. *w, w, w* is the bottom of the well that supplies the pump with water, and the surface of the water in the well may be as high as the line, *f, f.* *h* is the pipe for conducting the water from the well to the pump, *a, a,* and *t, t* is is the spindle on which the pump revolves. There is a water-tight joint at *m, m,* and another at *n*; the water in the casing, *d, d,* should not stand higher than the dotted line, *b, b,* and the space that is above that line in the casing is filled with air compressed to such an extent that it will balance the weight of the water in the pipe, *c, c.* It will be evident that water may be forced up to any required height by means of a pump of the kind now described. Should a constant supply of air be required for the air-vessel, it may be passed through the pipe, *h,* and the water-mill by means of a small bent pipe, placed in the position *s, s, s,* that pipe being fed by a small air-pump or a pair of bellows, worked by the power for driving the centrifugal pump.

Fig. 9.

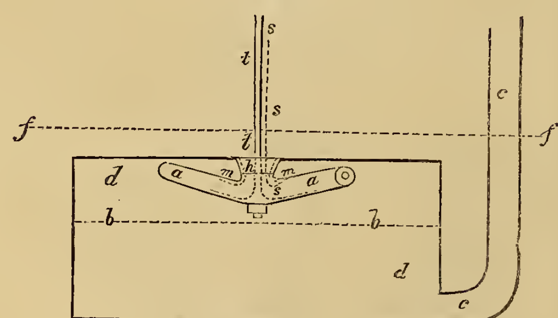
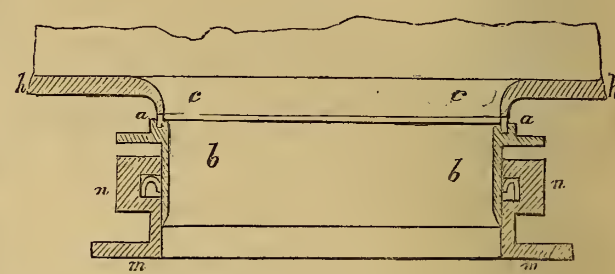



Fig. 9 shews another plan of forcing water by means of the centrifugal pump. The air-vessel rests flat on the bottom of the well, and the pipe, *h,* for leading the water to the pump, passes out at the top in place of the bottom of the air-vessel. The plan last described requires two water-tight joints, but this plan has only one water-tight joint at *m, m.* The position of the pipe for supplying air to the air-vessel is marked *s, s, s,* and the other letters in fig. 9 point out the same parts as the same letters in fig. 8 do.

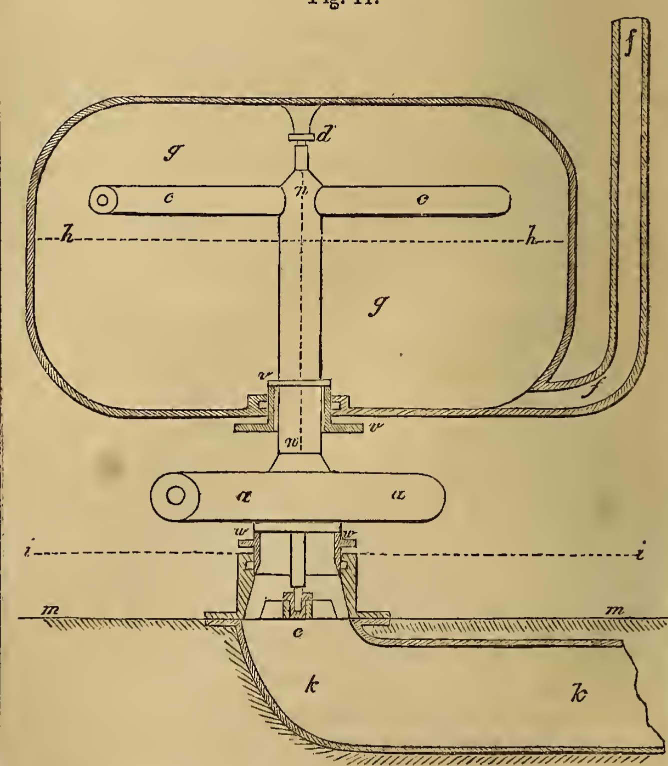
Fig. 11 is a plan of raising water by means of the centrifugal pump and the water-mill combined. *a, a,* is the water-mill, *c, c,* the arms of the pump, and *k, k* the pipe for supplying the water-mill and the pump with water. The pump, as in the two plans last described, works inside of the air-tight vessel, *g, g,* which is filled with water up to the dotted line, *h, h,* and has a pipe, *f, f,* for conducting away the water lifted by the pump. The water-mill and pump are fastened on the same spindle, *e, d,* and the tube or pipe, *n, n,* connected with the top side of the water-mill supplies the pump with water. There is a bearing at *e* for the bottom end of the spindle to work in, and there is another bearing for the spindle at *d.* *m, m* is the bottom of the canal which leads the water away from the water-mill, and *i, i,* represents the surface of the water in that canal. A water-tight joint at *v, v,* and another at *w, w,* will be required. The pipe, *k, k,* is fastened to the bottom of the tail-race, and the air-vessel will rest on pillars, or it may be supported in any other suitable way. As it is difficult to make the one arm of the pump so exactly of the same length of the other as to prevent the action of the pump from being destroyed by the centrifugal force of the water in the one arm overcoming that of the water in the other, we suggest that, in cases where it may be required, a plate, as represented by the dotted line, *n, n,* be placed in the upright tube to divide it, so that the one arm of the pump will be supplied with the water which will pass through the space on the one side of the plate *n, n,* the water for the other arm being made to pass through the space on

Fig. 10.




the other side of that plate. It is for the purpose of counteracting the evil now pointed out that we have turned the outer ends of the arms of the pumps represented in figs. 8 and 9 upwards. The air-vessel may be supplied with air in this plan in a similar way to that described for the other two plans already explained. It is scarcely necessary to remark that the main-pipe, *k, k,* will be connected to a stream or reservoir on a higher level than the water-mill, and that part of the water which will pass through that pipe will, after it has acted on the water-mill, be carried away by the tail-race, *m, m, i, i,* while the rest of the water which will pass

Fig. 11.




through the pipe, *k, k,* will, by means of the pump, be forced up the pipe, *f, f,* to the height to which it is intended to be raised. A cheap, simple, and efficient engine for extinguishing fires might be made according to the plan shewn in fig. 11. which kind of engine could be advantageously applied in almost all cases where towns are supplied with water conducted through the streets in pipes. For such cases the pipe, *k, k*, would only have to be temporarily connected to the pipe in the street by means of a leather pipe, coupled in the ordinary way, after the fire-engine was taken to the place where it would be required to operate. A fire-engine of this description would be much more portable than one of the ordinary kind, and very few hands would be required to manage it.

Fig. 10 represents a kind of water-tight joint, which will answer either for the water-mill or the centrifugal pump. The part *n, n, m, m*, is bolted to the main pipe, consequently this part is stationary. *c, c* is the central opening through which the water passes into the pump or water-mill, and the ring, *a, a*, round the underside of this opening revolves, as it in fact is in one piece with the arms. The part *b, b*, does not revolve, but it is at liberty to slide upwards or downwards some distance in the part *m, m, n, n*. The top of the part *b, b*, is kept in contact with the underside of the ring round the central opening by means of springs fixed in the space left betwixt the underside of the flanch which is outside of the part *b, b*, and the top of the part *m, m, n, n*, and the part *b, b*, is prevented from revolving by a pin which passes loosely through a hole bored in the flanch referred to, and is fastened into and at right angles to the top of the part *m, m, n, n*. The recess, *n, n*, has a Bramah's press leather inserted in it, and a ring of leather is also inserted in the groove at *a, a*, which is turned in the top of the part, *b, b*. It is this last mentioned ring of leather rather than the top of the part *b, b*, that is kept in contact with the ring round the central opening. These parts should merely be kept in contact by the springs—they should not be pressed hard or forced together. The water-tight joints at *m, m*, figs. 8 and 9, and the joint of the water-mill, fig. 11, will be of the kind now described. The water-tight joint at *n*, fig. 8, will be of the same construction as the joint at *v, v*, fig. 11.

Fig. 12.

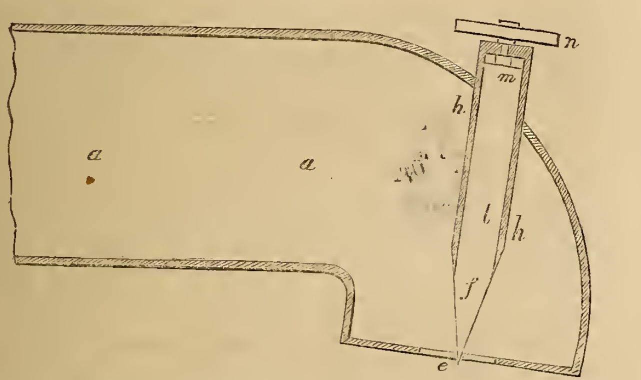



Fig. 12 is a plan of increasing or diminishing the area of the discharging orifices of the water-mill or centrifugal pump. *a, a*, is part of the arm, and *e*, the discharging orifice. *f* is a cone made in one piece with the cylindrical part *l m*, and *h h*, is a cylindrical tube which is fastened to the arm, and is made to receive the part *l m*. The part *l m*, is screwed inside, and the spindle the toothed pinion *n* is fastened to, is also screwed to work in the screw or nut formed inside of the part *l m*. The pinion, *n*, will, if it be turned round in one direction, force the cone into or towards the discharging orifice, and in this way diminish the area or size of that orifice, or if that pinion be turned the contrary way, the cone will, by being drawn out of or from the discharging orifice, leave a larger opening for the water to issue from. The pinion, *n*, may be worked by means of an arrangement of wheels similar to that described in the article on Barker's Mill, contained in No. XX. of the Artizan, (New Series,) and thus we have the means of either increasing or diminishing the size or area of the discharging orifices of the water-mills or pumps without stopping the machine.

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## Art. II.—RAILWAY SPECIFICATIONS No. II.

The bridge of which we now lay the specification before our readers, is not only a most instructive example of railway construction, and a work of interest only inferior to that appertaining to the celebrated Tunnel Bridge over the Menai Straits, but the specification itself is a very perfect specimen of that description of document, and will probably be found a useful guide to future constructors. The bridge is a cast-iron bridge of six arches, for conducting the Newcastle and Berwick Railway over the river Tyne. Mr. Robert Stephenson is the engineer, and the iron work has been contracted for by Messrs. Hawkes, Crawshay, and Sons, of the Tyne Iron Works ,for about £120,000.

### SPECIFICATION OF THE NEWCASTLE AND BERWICK RAILWAY.

*High Level Bridge.—Iron Work Contract.—Tender.*

*To the Directors of the Newcastle and Berwick Railway.*

Gentlemen, hereby propose to execute the several works in this contract, in accordance with the terms and conditions of the contract deed, specification, and drawings, and in every respect to the satisfaction of the Company's engineer for the sum of

have hereunto annexed the Schedule of Prices, from which the aggregate amount of this tender is actually computed.

And further undertake to guarantee and uphold the whole of the works contained in this contract, for twelve months from the date of the opening of the bridge for the Company's purposes and the public traffic.

And in case this tender is accepted, hereby undertake to execute a contract according to the draft referred to, within a fortnight from this date.

And propose

as sureties for the due performance and fulfilment of such contract.

Witness hand this day of August, one thousand eight hundred and forty-six.

Schedue of Prices, from which the aggregate amounts of the following works, included in the accompanying tender, are actually computed, and according to which prices the value of all additions to, or deductions from, the work specified and shown upon the drawings, are to be estimated.

The prices to be hereunto annexed are to include the cost of all centering, carriage, labour, fitting, fixing, and painting, complete.

The contractor is at liberty to add any other items to this schedule he may think fit.

| CAST IRON | | Price. |
|---|---|---|
| Main Ribs ... ... ... ... ... | per ton | |
| Spandril and Suspended Pillars ... ... ... | „ | |
| Cornices and Balustrade ... ... ... ... | „ | |
| Longitudinal Bearers to Carriage Road ... ... | „ | |
| Ditto to Railroad ... ... | „ | |
| Transverse (Trough) Girders to ditto ... ... | „ | |
| Gutters and Closing Plates ... ... ... | „ | |
| Rain Water Pipes, 4-inch diameter ... ... | per yard | |
| Head and Foot Pieces for ditto ... ... ... | each | |
| Bracing Frames to Spandril Pillars, and Pillars in the Approaches ... ... ... ... | per ton | |
| Ditto to Main Ribs ... ... ... | „ | |
| Square Pillars in the Approaches ... ... | „ | |
| Transverse Bearers of the ordinary shape in ditto | „ | |
| **WROUGHT IRON** | | |
| Links, in Tie Chains ... ... ... ... | per cwt. | |
| Turned Pins and Nuts for ditto ... ... ... | „ | |
| Suspension Bolts and Nuts ... ... ... | „ | |
| Straps and Bolts for Roadway Timbers ... ... | „ | |
| Holding-down Bolts to Pillars in the Approaches | „ | |
| Jagged Bolts to ditto in ditto ... | „ | |
| $\frac{3}{4}$ and $\frac{7}{8}$-inch ordinary Bolts and Nuts ... ... | „ | |
| 1-inch to $1\frac{1}{2}$-inch ditto ... ... ... | „ | |
| Two courses of 3-inch Memel Plankings, tongued, caulked, spiked down, and laid in the manner specified... ... ... ... ... ... | per sqr. yard | |
| One layer of Borradaile's Patent Felt, No. 2, saturated with Pitch and Tar, and laid between the courses of Planking, as specified ... ... | „ | |
| Wood Paving to be laid over the Carriage Road of the Six Arches, (6 inches thick,) from the Metropolitan Company, Prosser's patent ... | „ | |
| Seyssell's patent Asphalte, $1\frac{1}{2}$ inch thick, laid complete ... ... ... ... ... | „ | |

*Specification.*—The contract to be entered into under this specification is to comprise making, supplying, and erecting all the cast-iron, wrought iron, and wood work necessary for the construction and completion of a cast-iron bridge, with two curved approaches, on the Newcastle and Berwick Railway, crossing the Tyne at Newcastle, to be erected for the Company of Proprietors according to the designs, drawings, and instructions of Robert Stephenson, Esq. principal engineer to the Company.

The bridge is to consist of six cast-iron circular arches, on the bow and string principle, with a curved approach at each end, and may be termed a compound or double bridge, inasmuch as the railway will be carried over on the back of the arches in the usual manner, while underneath, by suspension from the same arches, a carriage road and footpaths will be formed.

The arches are to be uniform in size, character, and design—the span to be 125 feet, and the rise at the centre 17 feet 6 inches from the chord or centre line of the tie-chains, with a fall in each roadway of three inches from the centre towards the piers.

The approaches are to be formed of cast-iron pillars and bearers of a character corresponding with the general design of the bridge. Each approach will be about 251 feet in length. The railway will turn off at a curve at the termination of the arches, and the carriage road and footpaths underneath will proceed in a straight line until finished, and made good against the entrance gateways.

This contract is further to include the cost of all tools, labour, implements, and carriage, all machinery, such as cranes, crabs, blocks, ropes, and other tackle, and all centering, scaffolding, staging, temporary roads or railways, as well as all other material or labour that may be required for the due performance and perfect completion of the whole of the work, whether the same be particularly named and set forth in this specification or not.

The centering and staging must be constructed in a safe, substantial, and efficient manner, which shall be subject to the approval of the engineer; and all the tackle and machinery required in the execution of the work shall be of approved construction and strength, so as to be in every respect adequate to its intended purpose.

The whole of the work is to be executed according to the accompanying drawings, and to the true intent and meaning of this specification, aud is to be carried on and completed to the entire satisfaction, in every particular, of the Company's engineer.

The drawings relating to this contract, and referred to in this specification, are 12 in number, and are marked "Newcastle and Berwick Railway—High Level Bridge—Iron Work Contract," and numbered 1 to 12 as follows:—

No. 1. Elevation and plan of one entire arch, and of a portion of the adjacent arches.

No. 2. Transverse section of an arch, with details of the springing plates, and of the closing of the upper roadway girders with the piers.

No. 3. Longitudinal section of a portion of two adjoining arches, one portion being a section taken through the roadway, the other a section through the footpath, shewing the method to be adopted in bracing the ribs both laterally and vertically, with a plan of the bracing frames.

No. 4. Details of iron and wood work in the construction of the lower roadway and footpaths, also of the iron work for balustrades and cornice, and the method of affixing the same.

No. 5. Details of iron girders, wood bearers, planking balustrade, and cornice for the upper or railway portion of the bridge.

No. 6. Bracing frames to be fitted and fixed between the pillars, on the backs of the ribs over the footpaths, &c.

No. 7. Details of footings of the main ribs and fastenings of the tie-chains.

No. 8. Section at full size of the transverse trough girder for carrying the railway.

No. 9. Section of the main ribs at full size.

No. 10. Plan and details of girders and bearers in the approaches.

No. 11. Transverse and longitudinal section of same.

No. 12. Elevation of approaches and plan, shewing general arrangement and number of pillars.

*General description of the Work.—Arches.*

*Main Ribs.*—Each arch is to consist of four main ribs, each such rib being cast in five lengths or divisions, and every such length or division forming an exact and determinate portion of the circular arc of the whole rib, as shown on the drawings; to be put together by flange joints with bolts and nuts two inches in diameter. The flanges of the joints are not to be less than three inches in thickness, with brackets cast between each bolt-hole; they are to be well and truly faced throughout their surface, so as to form perfect abutting joints metal to metal.

The bolt-holes are to be drilled, and the bolts turned accurately to fit. The washers and insides of bolt-heads to be faced, and the backs of the flanges squared to the holes, so that when the bolts are screwed up, the heads and washers shall have a perfectly even and square bearing.

The footings of the main ribs and the springing plates bearing on the piers are to be planed or truly chipped and filed to a perfectly even bed, and to the proper line of rise for the arch.

Bosses are to be cast upon the main ribs, 14 inches square corresponding with the square pillars hereafter referred to: these bosses are to be set out in exact accordance with the distances figured upon the drawing, and must be exactly vertical at each point in the arch where they occur. They are to be lightened by circular cores, which will require very careful attention to ensure a precisely equal thickness of iron on all sides.

For further details and dimensions of the ribs, reference must be made to the drawings.

*Springing Plates.*—The springing plates are to be $2\frac{1}{2}$ inches thick, having pockets cast on them to receive the footings of the main ribs. Chipping fillets are to be cast in these pockets to correspond with similar fillets cast on the ribs, which are to be planed or truly chipped and filed, as before specified.

The external ribs will have a bearing of 4 feet 6 inches, and the internal ribs a bearing of five feet upon these plates.

Each plate is to be bolted down to the piers by four $1\frac{3}{4}$-inch holding-down bolts, and they will also be secured to each other in the manner shewn on the drawings.

In order to preserve the equilibrium of the piers, and to prevent the ribs of the arches from expanding or contracting in opposite directions, and thereby racking the structure, the ribs of every two adjoining arches resting on the same pier must be secured to the springing plates by keys and joggles, or by some other approved method, while, on the next piers on either side, the ribs must be left at liberty to expand and contract, and so on alternately throughout.

*Chains or Tie-Rods.*—The thrust from the arches is to be met and taken up by wrought iron tie-rods, made of the best *S. C.* mercantile iron, and linked together in the form of a chain, each link to be 7 inches deep by 1 inch thick.

The chains for each of the external ribs will consist of four such links, forming a sectional area of 28 square inches, and the chaius for each of the internal ribs will be composed of 8 such links, forming a sectional area of 56 square inches. The whole sectional area of the chains for the four ribs will therefore be equal to 168 square inches, but it is to be understood that the engineer is to be at liberty to alter the disposition of these links in any way he may think fit, either by giving greater strength to the external, and less to the internal, or the reverse.

The ends of the links, where they enter the ribs and where the cotter holes are formed, are to be increased to 8 inches in depth by $1\frac{1}{2}$ inches in thickness, and are to be secured to the ribs by double sets of gibs and keys.

The cotters are to be 8 inches deep by 2 inches thick. A draught of 3 inches is to be allowed in all the cotter holes, which are to be well formed with ends rounded to fit the gibs.

The link-pins are to be of wrought iron, turned all over, and to be $3\frac{1}{2}$ inches in diameter when finished. The washers are also to be turned, and the keys well fitted. The eyes in the links to be bored to fit the pins, and to be swelled out to 11 inches in depth, of the form and shape shewn on the drawings.

The holes in the footings of the ribs where the tie-chains are secured must be cast clean and true, to fit the tie-chains as nearly as possible. The cotter-holes are to be chipped and filed to correspond accurately with those in the links, and with the cotters and gibs.

The links composing each chain are to be got up in sets of an uniform length, properly adapted and fitted to their respective ribs.

*Upper Road or Railway.*

*Spandrils.*—The spandrils are to be formed of pillars 14 inches square as hereinbefore specified; each pillar to be cast sound and clean in one piece with the angles square and well up, and thickened internally at top and bottom as shewn on the drawings. The ends to be faced square and true in a lathe, and accurately adjusted to their proper and respective lengths.

The pillars at the commencement of the arch which are the longest, are not to be exceed 1 inch in thickness of metal, diminishing in a ratio proportionate to their lengths to a thickness of $\frac{3}{4}$ of an inch.

The bosses cast on the ribs are to be chipped and filed to a true horizontal face, so that when the pillars are mounted, they shall stand perfectly upright; they are also to be chipped and filed to fit sideways, having internal and external fillets cast for that purpose.

The pillars are to be securely and permanently fixed to the ribs by two sets of wrought iron folding-keys to each pillar, in the manner shewn on the drawings. The ends of these keys, when they are driven up and the work has been properly secured, are to be dressed off flush with the pillars.

*Longitudinal Bearers.*—The longitudinal bearers resting on the tops of the spandril pillars are to be of the form and section shewn on the drawing. Those portions which bear immediately on the faced end of the pillars are to be planed and made perfectly true, so as to take an even bearing and make a close joint.

These bearers are to be jointed together by abutting joints, secured by four $1\frac{1}{4}$-inch cotter bolts, and it is proposed that they shall be cast in lengths of 20 feet each. There will be no objection to shorter lengths, should the contractor desire them for his own convenience, but it is to be understood that no allowance will be made for extra joints.

*Transverse Girders.*—These are to be of the form commonly called "trough girders," and are to extend across the whole width of the bridge, the length will be about 37 feet 6 inches, the depth 1 foot 9 inches in the centre, and 1 foot 6 inches at the ends; the thickness of the sides to be 1 inch, and of the bottoms, which will bc moulded and panelled, not less than $1\frac{1}{2}$ inches on the average.

The girders will rest on the longitudinal bearers immediately over the spandril pillars of the 4 main ribs; dove-tailed joggles are to be cast at the points of bearing, so as to clip each other, as shewn on the drawings, and wrought iron wedges are to be fitted and driven, so as effectively to secure the one to the other.

Chipping fillets are to be cast on the upper side of the longitudinal bearers, aud on the under side of the transverse girders, for the purpose of adjustment, so that the latter shall have an equal and fair bearing on all the four ribs.

Pockets are to be cast on the sides of these girders, into which the longitudinal timbers for carrying the railway and planking are to be well fitted.

*Planking*.—The railway over the bridge is to be formed of two courses of 3-inch planking, laid diagonally, to be ploughed, and to have hoop iron tongues inserted, and to be securely spiked down to the longitudinal timbers by wrought iron spikes 9 inches long and $\frac{5}{8}$ of an inch square. Two spikes to be driven into each plank where it crosses the timbers; the under side of the planking is to be planed and dressed throughout.

The longitudinal timbers are to be planed on three sides and chamfered on the bottom edges. The planking is to be caulked so as to be water-tight, and between the two courses is to be placed a layer of thick felt, saturated with tar and pitch, or such other material as the engineer may direct. The quality of the felt to be No. 2. Borrodaile's Patent.

*Balustrade and Cornice.*—The posts of the balustrade are to be 14 inches square, and are not to exceed $\frac{5}{8}$ of an inch in thickness, they are to be fixed on the ends of the transverse girders, and bolted thereto by four 1-inch bolts and nuts.

Each bay of balustrade is to be cast in one length, and fitted into the slots or grooves cast in the posts, as shewn on the drawings. The capping to be cast in lengths to break joint over the centre of each bay—the ends to be chipped and filed to make close joints, and to be well secured to the balustrade by $\frac{5}{8}$-inch screw-pins.

The cornice will be cast in lengths, and put together by flange joints (with $\frac{3}{4}$ of an inch bolts and nuts,) perfectly true and fair on the outside, and chipped and filed to a close fit, so as to have the appearance of one uniform casting from end to end. The closing plates at the back of the cornice will form the gutters; they are to be cast $\frac{1}{2}$-inch thick, and to be put together by socket joints made water-tight by means of flannel strips and stiff putty.

The cornice will be secured to the ends of each transverse girder by four $\frac{7}{8}$-inch countersink bolts and nuts, and will also be fixed and bolted to the longitudinal bearers by $\frac{3}{4}$-inch bolts.

The joints around the posts of the balustrade are to be well and closely made with iron cement. A recess will be cast in the upper side of the cornice to correspond with those in the pillars. The balustrade is to be fitted into the same on a bed of strong red and white-lead putty, and bolted down by $\frac{3}{4}$-inch bolts and nuts, as shown in the drawings.

*Bracing Frames and Plates.*—Bracing plates are to be fitted between each pair of ribs over the footways, of the pattern and dimensions shown on the drawings, and to be bolted to flanges cast on the ribs by 1-inch bolts and nuts. A 2-inch wrought iron bolt will pass through these plates, and be screwed up outside the ribs between each pillar, so as to bind and secure the whole together in the most effectual manner. The plates are to bed fairly on the flanges, and to be wedged up closely to the ribs by iron wedges. All the joints are to be filled in and well caulked with iron cement.

Bracing frames are also to be fitted between the spandril pillars over the footways; they are to be chipped and filed to fit the abutting lugs cast on the pillars, and to be bolted thereto by 1-inch bolts and nuts; wrought iron wedges must be driven where required, and the spaces must be filled in and well caulked with iron cement, as before specified.

*Carriage Roadway and Footpaths.*—This roadway will be suspended from the main ribs by wrought iron rods or bolts, in the manner described in the drawings. The rods are to be enclosed in square cast-iron casings or pillars, to correspond with the spandrils and bosses cast on the main ribs; the body of these casings is not to exceed $\frac{3}{4}$ of an inch in thickness; the bottoms are to be strengthened, as shewn on the drawings, and to have pockets cast to receive cast-iron longitudinal bearers, which must be fitted into them bolted and wedged, and then run with lead, so as to constitute, as nearly as possible, one rigid and inflexible bearer throughout.

The tops are to be faced so as to make a close fitting joint with the bosses cast on the ribs. The longitudinal bearers are to be stayed to each other beneath the footpaths by cast-iron stay-pipes, with 1-inch bolts and nuts passing through the same; the pipes are all to be faced in the lathe to their proper lengths, and the bosses on the bearers must be faced to fit.

The transverse roadway bearers are to be whole timbers, well selected, and perfectly free from imperfections of any kind, each to be 12 inches wide, 14 inches deep in the centre, and 12 inches deep at the ends. There will be three of these timbers between each suspending pillar; the ends must be well fitted into the pockets cast on the longitudinal bearers, and are to abut closely against the sides thereof. Wrought iron straps and bolts are to be attached to the centre bearers between each set of pillars of the size and in the manner shown on the drawings, for the purpose of bracing and tying the roadway and footpaths together, in order that, throughout the whole length of the bridge, they may form one inflexible platform.

The planking of this roadway is to be of the same substance as that of the upper road or railway, and to be laid in a similar manner, except that the bearers and the underside of the planking will not require to be planed.

The footpaths are to be laid with two courses of 2-inch planking, crossing each other at right angles. The timbers under the footpaths, to which the planking is to be securely spiked down, are to be 6-inches thick, and of the depth shewn on the drawings.

The gutters are to be of similar pattern to those for the upper roadway, and will form the curb or closing plates to the footpaths. They are to be half-inch thick, bracketted and secured to their places in a firm and substantial manner. The joint between the abutting ends of the planking and the sides of the gutters is to be caulked and made water-tight.

The carriage road will be paved with wood blocks, 6 inches thick, and on an approved plan, or by a layer of asphalte of the best and most suitable description as the engineer may direct. The cost is to be determined by the Schedule of Prices hereinbefore referred to.

*Balustrade and Cornice.*—The balustrade and cornice will be of the same pattern and design as those for the upper roadway, cast in similar lengths, and put together in like manner. The mode in which they are to be fixed and secured is fully detailed in the drawings.

A cast-iron fence-rail is to be fitted between each of the pillars of the inner ribs, in order to separate the footpaths from the carriage road throughout the whole length of the bridge. The size and manner of fixing by wrought iron keys is shown upon the drawings.

The continuation of the lower roadway over the piers between the arches is to be formed by longitudinal and transverse timbers, planked and laid as provided for the roadway.

Provision must be made in both the upper and lower roadways for the expansion and contraction of the arches.

*Approaches.*—The specification already given for the arches will also apply to the approaches when work of a similar description occurs.

There are to be two approaches to the bridge, one at each end, as detailed in drawings Nos. 10, 11, 12. They are to be precisely alike in length, number of columns, and bearers, but the curves of the railway may be slightly varied.

The bottom roadway, footpaths, stone cornice, and footings for the pillars are not included in this contract, and will be done by other parties, but the contractor must see to the proper bedding of the footing stones, and is to fix the columns thereon in a perfectly upright and secure manner.

The external pillars are to be bolted down on the stone footing to the masonry of the arches by $1\frac{1}{4}$-inch holding-down bolts with cotters and washers, of the length shown on the drawings.

All the internal pillars will be bolted to the stone footings by $1\frac{1}{4}$-inch jagged bolts let into the stone six inches, and run with lead.

The pillars are to be 21 feet $6\frac{1}{4}$ long and 14 inches square, thickness at bottom $1\frac{1}{8}$ inches tapering to $\frac{7}{8}$ths of an inch at top. The tops are to be faced to receive the longitudinal bearers in the manner that has been specified for the arches.

The longitudinal bearers, transverse girders, and balustrade and cornice for the straight part of the approaches will be of the same model, shape, and design as those for the arches. The longitudinal bearers and cornice for the curved parts, are to be cast to the proper sweep, and jointed together as for the straight parts.

The transverse girders in these curves are to be of the ordinary I shape, having pockets cast on them to receive the longitudinal timbers of the railway, and are to be of the depth and thickness shown on the drawings.

Bracing frames are to be fixed between the pillars as provided for in the arches. The longitudinal bearers from the points G to H on the plan drawing No. 10, are to be cast one inch thick on the sides, and to be prepared with footings and joggles in the proper situation to receive the ends of the transverse bearers of the circular approaches, which are to be securely fixed thereto by wrought iron wedges and by $1\frac{1}{4}$-inch bolts and nuts—two bolts and nuts to each girder.

Joggles or slots are to be cast on the transverse girders of the straight part of the approach, in the positions shewn on the drawings, and cast-iron plates $\frac{5}{8}$ths of an inch thick, are to be made to slide into the same, to close up and conceal the ends of the girders in the circular approaches.

The whole upper surface of the approaches is to be planked with two layers of 3-inch planking, made water-tight, in the manner specified for the arches.

Closing plates, forming gutters to carry off the water, are to be fitted to the inside of the cornice, as specified for the arches; and rain water fall-pipes 4 inches in diameter, with proper head and foot, are to be supplied and fixed in the position shewn on the drawings, or in such other situation as the engineer may direct; similar pipes are also to be fixed at each of the piers for the purpose of taking the water from both roadways of the bridge.

Provision must be made in the longitudinal bearers and cornice to admit of expansion and contraction.

*Fixing Chairs and Rails.*—The chairs and rails required will be supplied by the Company, but the contractor is to fix the same throughout the whole length of the arches and approaches at the proper level and gauge, and is to provide all the blockings for the chairs, which are to be not less than 12 inches square, made of well-seasoned oak, and dressed to a proper level to receive the chairs.

The contractor is to provide the necessary wrought iron pins for fixing the chairs, and also the keys for securing the rails thereto, which are to be made of well-seasoned compressed oak or elm timber.

The contractor must make proper provisions for expansion and contraction in the rails where requisite over the arches, and is to lay the railway in a secure and efficient manner, and in every respect to the entire satisfaction of the engineer.

*Materials and Workmanship.*

*Model Floor.*—It is presumed the contractor will have a model floor sufficiently large to enable him to set out one half of an arch at full size. If not, he will be required to lay such floor for the purpose. It must be protected from the weather so as to be perfectly dry at all times. When the arch is so set out, the contractor is to give notice to the principal engineer, who will inspect the same, or appoint a qualified person to do so; and the contractor will be bound to alter or modify any of the parts to meet the views of the engineer or of his representative.

*Fitting at the Manufacturer's Premises.*—Every arch is to be fitted and erected with all its parts in a complete and perfect state (except the timber work,) before leaving the manufacturer's premises, and all the parts thereof are to be distinctly marked to their places, so that when the work is delivered on the ground for the purpose of erection, nothing more in the way of fitting shall require to be done.

*Testing.*—On the erection of each arch, as above specified, the contractor is to give proper notice in writing to the engineer, who will either personally or by deputy, inspect the same, and cause such test to be applied as he may think fit. The engineer will require that not less than 300 tons shall be laid on, uniformly distributed over the two roadways. The contractor is to make every arrangement and provision for the testing, and to defray all the costs and charges attending the same, and,should any portion of the work fail, or, in the opinion of the engineer, not stand the test satisfactorily, the contractor will be held responsible for the defect, whatsoever the cause may be, and will be required to adopt immediate measures for rectifying it in such manner as may be approved of by the engineer. Each of the links forming the tie-chains is to be tested separately with a weight equal to 9 tons on every square inch of section.

*Painting.*—No part of the work is to be painted until it has been inspected and tested but immediately after, and before it leaves the manufacturers premises, the work is all to receive one coat of anti-corrosion paint, of an approved quality and colour, and, after erection, the whole of the iron work is to receive two additional coats, and the wood work four. The finishing coat to be of such colour as may be directed by the engineer.

The ends of all the timber bearers are to be thickly paid with a coat of good stiff white-lead paint, previous to their being fixed into the pockets of the cast-iron girders or bearers.

*Centering.*—In order to prevent interruption or delay in the erection of the arches arising from the removal of the centering, the contractor will be required to provide two centerings with the needful tackle and appendages, should the engineer deem it necessary.

The contractor is to submit to the engineer for his approval, the plan proposed to be adopted for the centerings, and shall be bound to carry into effect, to the engineer's satisfaction, any alteration he may consider desirable therein.

The contractor is to give due notice to the engineer when he may be desirous of striking or removing the centering from under any of the arches, and is not to strike or remove such centering without the engineer's sanction.

*Cast-iron.*—All the castings to be of clean, sound, good work, perfectly straight, and free from blemishes and imperfections of any kind.

The whole of the iron to be good strong grey iron, well selected and of approved quality.

The main ribs are to be cast from cold blast iron exclusively, and none of the castings are to contain more than one-third of hot blast. Should any of the castings appear to the engineer to be defective, or to contain unsuitable metal, they will be rejected.

*Wrought iron.*—The whole of the wrought iron work is to be of the best S. C. mercantile iron, soundly forged, of good clean workmanship, and free from scales or seams, otherwise it will be rejected.

*Screw-bolts.*—The screws are all to be cut with dies, with a well proportioned and full thread; the heads and nuts are to be square upon the bolts. No screw bolts to be used without washers.

*Timber.*—The whole of the bearers and planking must be of the best Memel or Dantzic timber, perfectly sound and clean, free from sap, shakes, or other imperfections, and subject to Payne's patent process, or to such other process to secure preservation as the engineer may direct, previous to fixing.

*Dimensions.*—All dimensions given in this specification, or written upon the drawings are to be taken in preference to dimensions by scale, and all plans drawn to a large scale are to be followed in preference to those drawn to a small scale, but in all cases of ambiguity reference is to be made to the engineer as hereinafter provided.

The contractor is to drill all bolt-holes in the stone work where required for the purpose of fixing his work thereto, and is to find all lead for running the bolts.

*Conditions.*

This contract is to include every item of labour, or material, of all descriptions necessary for the perfect completion of the work required to be done, whether the same be particularly set forth in this specification and shewn on the drawings or not, unless specifically excepted herein, and also the maintenance of the whole in repair for twelve months after completion.

The whole of the work is be executed and completed in workmanlike manner to the entire satifaction of the company's engineer, both as regards the mode of operation and the quality of the materials employed, and according to the true intent and meaning of this specification, and of the accompanying drawings, in respect of which, the said engineer shall be sole judge, and his decision thereon shall be final and binding upon the contractor.

*Time.*—The works are to be commenced immediatly on an order being given by the engineer, and they are to be in every respect rompleted so as to be available for public traffic, and for the purposes of the Company, on or before the first day of August, one thousand eight hundred and forty eight.

*Delivery.*—All work to be supplied in pursuance of this contract must be delivered in a sound and perfect condition, free of all charge and expense.

*Guarantee and risk.*—The contractor is to guarantee the stability of the whole and every part of the work, and is to keep the whole in repair for twelve months after the opening of the bridge or completion of the work, as hereinbefore specified, taking the risk of all accidents that may occur during that period; he must replace immediately any defective work that may be discovered, and must make full compensation for any loss or damage to which the Company may be subjected by reason of defective materials, or in consequence of any negligence on the part of the contractor, or of those employed by him on the works.

The contractor is also to take all risk of accidents, and to make good any damage or injury that may occur to the work during its progress.

*Foremen, Watchmen, &c.*—The contractor shall employ competent foremen to superintend the works, one of whom shall always be in attendance during the progress of the works, and he shall also employ and maintain at all times, a careful and sufficient watch in every department. Such foremen and watchmen are to attend to all orders and directions which may be given to them by the company's engineer, and should they at any time fail to do so, they may immediately be discharged by the said engineer, and the contractor is without delay, to replace them by others.

Should it any time become necessary to call in the assistance of the police force, or of the local constable headboroughs or authorities on any matter arising out of the carrying on of these works, the contractor is to pay the expenses thereof.

*Inspection.*—The engineer will appoint an inspector or superintendent to attend to the progress of the work, to whose directions the contractor is in all cases to conform. Such inspector will have authority to condemn and reject any work that he may consider defective or unsuited to its intended purpose, and the contractor is immediately to replace and make good any work so rejected and condemned. The contractor is to allow such inspector or superintendent free access at all times to any building, workshop, factory, yard, or place in which any portion of the work to be executed under this contract may be in progress or may be deposited, and such inspector or superintendent shall have power to condemn or reject any work that may so come under his cognizance, the same as if it had been brought to and delivered at the place where it is to be erected.

*Alterations and Prices.*—The engineer will be at liberty to make any alterations in the work that he may consider necessary, without in any way vitiating this contract or impairing the force of any of its conditions, and the contractor is to execute such alterations accordingly, but, in order to prevent any dispute as to prices, the contractor is to furnish to the engineer a detailed schedule of prices for all materials and labour required in the execution of the work, and all deductions or additions on account of alterations shall be calculated according to such schedule. The contractor must not make any alteration in the work without an order from the engineer.

The detailed schedule above referred to is to remain in the custody of the engineer, and is not to be made use of except for the purposes of this contract.

*Power of Engineer to remove, &c.*—The contractor is at all times to keep such a number of men employed, and so proceed with the execution of the works as may be required by the engineer, and the engineer shall have full power, whenever he may consider it necessary for the due performance of the work, to employ any additional number of men, or order any additional quantity of material at the expense of the contractor; and should the neglect or default of the contractor render it necessary, in the opinion of the engineer, to take the work wholly, or in part, out of the hands of the contractor, the Company shall have power to do so, and to take possession of the whole of the materials, tools, or implements used by the contractor, or of such parts thereof as the engineer may consider requisite for carrying on and completing the work, and all extra charges or expenses which may be incurred in so remedying the neglect or default of the contractor shall be defrayed by him or his sureties.

*Drawings.*—The contractor is to make for himself, and at his own expense, such working drawings as he may require.

*Deputies.*—In addition to the inspector or superintendent hereinbefore referred to, the engineer is to be at liberty to appoint such other deputies as he may think fit to act as his representatives in his absence.

*Reference.*—In all cases of difference of opinion as to dimensions or details, or on any other matter connected with the execution of the work, or should any difference of opinion arise between the company and the contractor after the completion of the work, touching any question of charge or account between them, it shall be referred to the engineer, whose decision shall be final and binding.

*Bond.*—The contractor is to enter into a bond with two sureties who are to be subject to the approval of the directors

for the due fulfilment of all the conditions of this contract.

*Indenture.*—The company's solicitor will prepare the indenture of contract and bond, but the contractor will be required to pay for the stamps and all other expenses attending the same.

*Tender.*—Tenders are to be sent in according to the form furnished, and parties tendering, must state the names, occupations, and residences of two persons willing to join them in the bond previously referred to.

The Directors no not bind themselves to accept the lowest tender.

*Payments.*—As soon as the contractor has 250 tons of good and approved castings, and a proportionate weight of wrought iron work ready at his works, the engineer shall certify the same, and they shall be paid for at the rate at which the tender is made subject to a deduction of £10 per centum —to be retained in the hands of the company until the whole of the works are completed.

The engineer or those appointed under him, are to have full power of making such experiments on the materials selected by the contractor for the purposes of this contract as the engineer may deem necessary, such experiments to be made on the contractors premises, and the contractor is to make every necessary provision for carrying out the same, and to defray all costs and charges attending thereon.

Parties tendering are to include in the amount of their tender the sum of £2,800, in order to provide for lamps, gas-pipes, and other fittings for lighting the bridge, and also to meet any contingencies that may arise from work not contemplated in the specification; and should the whole or any part of the above amount not be required, a corresponding deduction will be made from the contract sum; and should any such work be required as above alluded to, the rate at which it is to be charged and paid for, will be determined on and fixed by the engineer from the Schedule of Prices annexed to the tender.

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### THE NEWCASTLE AND BERWICK RAILWAY.

August, 1846.

*Estimate for the Iron Work for the High Level Bridge at Newcastle.*

The contract comprizes the erection of the iron work and timber planking for the entire completion of the bridge, roadway, and approaches, including hoisting, fixing, staying, machinery, tools, &c. &c. &c.

The contractors must provide two sureties to the extent of 10 per cent. on the amount of the tender.

The whole of the works to be completed fit for traffic of the public and railway on or before the 1st day of August, 1848.

The attention of the contractors is directed to the specification, especially for the mode of fitting and fixing the several parts.

#### PART No. 1.—THE SIX ARCHES.

*Cast Iron Work.*

| Tons | cwt. | qrs. | lbs. | | £. | s. | d. |
|---|---|---|---|---|---|---|---|
| 59 | 14 | 2 | 0 | In No. 24 springing plates, or shoes for main rib ... ... ... ... ... | | | |
| | | | | No. 2, patterns for ditto, 10ft. 1½in. × 5ft. 6in. | | | |
| 1103 | 8 | 2 | 14 | In No. 24 main ribs, (each rib cast in 5 pieces.) | | | |
| | | | | No. 1 pattern for main rib 2 in. thick, 136 ft. around, 3 ft. 6in. deep in centre, and 3 ft. 9in. at ends in 5 pieces ... ... ... ... | | | |
| | | | | No. 1 ditto ditto but 3in. thick ... | | | |
| 183 | 11 | 1 | 21 | In No. 288, spandrill hollow pillars, fixed on main ribs to carry railway ... ... ... | | | |
| | | | | No. 1 pattern for do. 14in. sqr. & 0ft. 9½in. long | | | |
| | | | | „ 1 do. do. 14 „ 2 3 „ | | | |
| | | | | „ 1 do. do. 14 „ 4 7 „ | | | |
| | | | | „ 1 do. do. 14 „ 7 10 „ | | | |
| | | | | „ 1 do. do. 14 „ 12 0 „ | | | |
| | | | | „ 1 do. do. 14 „ 17 3 „ | | | |
| 254 | 2 | 0 | 7 | In No. 348, bracing frames bolted between ribs, &c. &c. ... ... ... ... ... | | | |
| | | | | No. 2, patterns for ditto, 5ft. 0in. × 3ft. 6in. | | | |
| | | | | „ 2, ditto ditto, 6 4 × 1 6 | | | |
| | | | | „ 5, ditto ditto, 10 2 × 6 9½ | | | |
| 72 | 9 | 2 | 21 | In No. 144, bracing frames between pillars ... | | | |
| | | | | „ 1, pattern for ditto 6ft. 2in. × 5ft. 6in. | | | |
| | | | | „ 1, ditto ditto 6 2 × 6 2 | | | |
| | | | | „ 1, ditto ditto 6 2 × 6 7 | | | |
| | | | | „ 1, ditto ditto 6 2 × 8 6 | | | |
| 217 | 12 | 2 | 21 | In No. 170, longitudinal bearers over spandril pillars ... ... ... ... ... ... | | | |
| | | | | No. 3, patterns with pannelled soffits, each about 20 ft. long ... ... ... ... ... | | | |
| 367 | 14 | 3 | 7 | In No. 84, transverse girders ... ... ... | | | |
| | | | | No. 1, pattern for trough girder, with pannelled soffit and shoes cast on sides for timber 37 ft. 6in. long ... ... ... ... | | | |
| 250 | 18 | 3 | 21 | In No, 288, spandril hollow pillars to case the suspending rods for lower roadway ... ... | | | |
| | | | | No. 1, pattern for ditto, 14in. sqr. & 3ft 6in. lg. | | | |
| | | | | „ 1, ditto ditto, 14 „ 8 2 „ | | | |
| | | | | „ 1, ditto ditto, 14 „ 11 8 „ | | | |
| | | | | „ 1, ditto ditto, 14 „ 14 3 „ | | | |
| | | | | „ 1, ditto ditto, 14 „ 16 1 „ | | | |
| | | | | „ 1, ditto ditto, 14 „ 16 11 „ | | | |
| 164 | 6 | 3 | 21 | In 312, longitudinal bearers for carriage road, fitted in between bottom of pillars ... ... | | | |
| | | | | No. 1, pattern for ditto, with shoes cast on sides, 5ft. 0in. long ... ... | | | |
| | | | | 1, „ 5 3 „ ... ... | | | |
| | | | | 2, „ 8 8 „ ... ... | | | |
| 53 | 9 | 2 | 7 | In fascia under lower cornice ... ... ... | | | |
| | | | | No. 1, pattern for ditto, 9ft. 11in. long, mitred round pillars ... ... ... ... ... ... | | | |
| 60 | 11 | 1 | 7 | In lower cornice... ... ... ... ... | | | |
| 81 | 6 | 0 | 14 | In upper cornice... ... ... ... ... | | | |
| | | | | No. 1, pattern for cornice between pillars 6ft. 6in. long ... ... ... ... ... ... | | | |
| | | | | No. 1, ditto, 3ft. 4in. long, mitred round pillars | | | |
| 11 | 17 | 1 | 14 | In plain closing plate to back of lower cornice | | | |
| | | | | No. 2, patterns for ditto, 4ft. 0in. long ... | | | |
| | | | | „ 1, „ „ 8 9 „ ... | | | |
| 31 | 1 | 0 | 21 | In No. 156, closing plates and trough gutters at back of upper cornice ... ... ... | | | |
| | | | | No. 1, pattern for ditto, 10ft. 3in. long ... | | | |
| 37 | 7 | 1 | 7 | In No. 144, hollow pedestals to upper parapets | | | |
| | | | | No. 1, pattern for ditto, 4ft. 7in. high, and 14in. square ... ... ... ... ... | | | |
| 72 | 13 | 3 | 0 | In No. 156, bays of balustrade railing to upper roadway ... ... ... ... ... | | | |
| | | | | No. 1, pattern for ditto, 8ft. 10½in. long by 3ft. 7½in. high ... ... ... | | | |
| 63 | 10 | 3 | 14 | In No. 156, bays of balustrade railing to lower roadway ... ... ... ... ... | | | |
| | | | | No. 1, pattern for ditto, 8ft. 9in. long... ... | | | |
| 23 | 9 | 3 | 21 | In moulded capping, grooved and screwed on the upper balustrade railing ... ... ... | | | |
| | | | | No. 1, pattern for capping, 9ft. 11in. long, mitred round pedestal ... ... ... | | | |
| 17 | 9 | 0 | 21 | In moulded capping, grooved and screwed on lower balustrade railing ... ... ... | | | |
| | | | | No. 1, pattern for ditto, 8ft. 9in. long... ... | | | |
| 34 | 1 | 0 | 7 | In trough gutter, for drainage of lower roadway ... ... ... ... ... ... | | | |
| | | | | No. 1, pattern for ditto, 10ft. 3in. long ... | | | |
| 14 | 1 | 0 | 7 | In No. 288, hollow pipes, 3in. dr., and 7ft. 5in. long as stays between the longitudinal girders of carriage road ... ... ... ... | | | |
| | | | | No. 1, pattern for ditto ... ... ... ... | | | |
| 8 | 7 | 2 | 14 | In No. 168, hollow pipes, 3in. dr. and 9ft. 1in. long, as fence rail between pillars next footway | | | |
| | | | | No. 1, pattern for ditto ... ... ... ... | | | |
| 9 | 7 | 0 | 0 | In No. 1200, washers for bolts ... ... ... | | | |
| | | | | No. 3, patterns for ditto ... ... ... | | | |
| 1 | 10 | 2 | 7 | In No. 120, brackets to support the chains or tie-rods to ribs ... ... ... ... | | | |
| | | | | No. 2, pattern for ditto ... ... ... ... | | | |

| Yds. | feet | ins. | | £. | s. | d. |
|---|---|---|---|---|---|---|
| | 1210 | 0 | Run. 4-inch cast-iron rain pipe and fixing to convey water from roadways ... ... ... | | | |
| | | | Extra to 20 elbows in ditto ... ... ... | | | |
| | | | No. 10, branch pieces in ditto ... ... ... | | | |
| | | | No. 20, heads to 4-in. rain pipe ... ... | | | |
| | | | No. 20, perforated gratings over heads... ... | | | |
| | | | Bedding 24 shoes or springers to main ribs with cement as described ... ... ... ... | | | |
| | | | Running the ends of 144 longitudinal girders into sockets, cast on pillars with lead, (12 lbs. to each) ... ... ... ... ... | | | |

| Yds. | feet | ins. | | | £. | s. | d. |
|---|---|---|---|---|---|---|---|
| | | | | Ditto ditto of 144 ditto (15 lbs. to each) ... | | | |

*Wrought Iron.*

| Tons | cwt. | qrs. | lbs. | | £. | s. | d. |
|---|---|---|---|---|---|---|---|
| 4 | 9 | 1 | 0 | In No. 96, hold-down bolts to shoes at springing of ribs, $1\frac{3}{4}$ dr. and 13 ft. 0 in. long ... | | | |
| | 4 | 3 | 7 | In gibs and nuts to ditto ... | | | |
| 198 | 13 | 0 | 0 | In chains or tie rods to arches, as described in specification ... | | | |
| 7 | 6 | 1 | 0 | In No. 48, sets of cotters and gibs to ditto ... | | | |
| 8 | 11 | 2 | 0 | In No. 288, pins with nuts and washers to joints of chains ... | | | |
| 13 | 11 | 0 | 7 | In No. 144, suspending bolts to outer ribs, each 23 ft. long, partly $1\frac{1}{2}$ in. dr. and partly 2 in. dr. | | | |
| 22 | 2 | 3 | 0 | In No. 192. suspending bolts to inner ribs, each 22 ft. 6 in. long and 2 in. dr. ... | | | |
| 1 | 19 | 0 | 21 | In nuts, gibs, and cotters to suspending bolts ... | | | |
| 4 | 2 | 3 | 0 | In No. 108, tie bolts between inner and outer ribs, (average 8 ft. 3 in. long and 2 in. dr.).... | | | |
| | 9 | 2 | 7 | In nuts, washers, &c., to ditto ... | | | |
| 2 | 12 | 0 | 0 | In No. 288, tie bolts between the longitudinal girders of lower roadway, (each 1 in. dr. and 7 ft. 9 in. long ... | | | |
| | 4 | 1 | 7 | In nuts &c., to ditto ... | | | |
| 4 | 7 | 0 | 21 | In No. 576, bolts to joints of main ribs (2 in. dr. and under 12 in. long,) including nuts, washers, &c. ... | | | |
| 4 | 1 | 3 | 21 | In No. 2808, bolts to secure bracing frames to ribs, (1 in. dr., and under 12 in. long,) including nuts, washers, &c. ... | | | |
| | 14 | 3 | 0 | In No. 720, bolts to secure bracing frames to each other, (1 in. dr. and $4\frac{1}{2}$ in. long,) including washers, nuts, &c. ... | | | |
| 1 | 2 | 2 | 21 | In No. 1536, bolts to secure the vertical braces to pillars $\frac{7}{8}$-in. dr. and $5\frac{1}{2}$ in. long,) including nuts, washers, &c. ... | | | |
| 3 | 6 | 3 | 21 | In cotters to secure the spandril pillars to main ribs ... | | | |
| 1 | 13 | 2 | 0 | In No. 768, bolts, ($1\frac{1}{4}$ in. dr. and 8 in. long,) to secure the longitudinal bearers of upper roadway to each other ... | | | |
| | 11 | 0 | 14 | In No. 288, bolts ($\frac{7}{8}$-in dr. and 1 ft. 8 in. long, to secure the longitudinal girders of the lower roadway to pillars ... | | | |
| | 6 | 2 | 7 | In No. 288, bolts ($\frac{3}{4}$-in. dr. & 1 ft. 5 in. long, for ditto ditto ... | | | |
| | 7 | 0 | 21 | In 96, bolts ($1\frac{1}{4}$ in. and $1\frac{1}{2}$ in. dr. 14 in. long,) to secure the end of longitudinal girders to main ribs ... | | | |
| | 3 | 1 | 14 | In No. 60, bolts with eye on end to support the chains of outer ribs, (1 in. dr. and 15 in. long,) including pins, nuts, cotters, &c. ... | | | |
| | 4 | 2 | 21 | In No. 60, ditto ditto for inner ribs, ($1\frac{1}{4}$ in. dr. and 15 in. long,) including nuts, cotters, &c. ... | | | |
| | 11 | 0 | 21 | In No. 576, bolts (each $\frac{7}{8}$-in. dr. and 9 in. long,) to secure lower fascia to girders, the heads countersunk ... | | | |
| | 8 | 0 | 21 | In No. 468, bolts ($\frac{7}{8}$-in. sqr. and 5 in. long,) to secure the joints of fascia to each other ... | | | |
| 3 | 13 | 3 | 14 | In No. 8892, bolts (each $\frac{3}{4}$-in. dr. and 3 in. long,) to upper and lower cornices ... | | | |
| | 7 | 0 | 0 | In No. 624, bolts ($\frac{7}{8}$-in. dr. and $4\frac{1}{2}$ in. long,) with the heads countersunk to secure the cornice to ends of transverse girders ... | | | |
| | 14 | 1 | 21 | In No. 1248, bolts ($\frac{3}{4}$-in. dr. and 7 in. long,) to secure railing to cornice, the heads countersunk ... | | | |
| | 10 | 1 | 0 | In 288, bolts ($\frac{7}{8}$ in. dr., and 18 in. long,) to secure railing to pillars ... | | | |
| | 10 | 3 | 0 | In No. 576, bolts (1 in. dr., and 4 in. long) to secure the pedestals of upper ballustrade to longitudinal girders ... | | | |
| | 2 | 3 | 21 | In No. 1872, screw pins ($\frac{5}{8}$-in. diameter, and 2 in. long,) to secure capping to railing, the heads countersunk ... | | | |
| | 1 | 0 | 7 | In No. 288, cotters, ($\frac{1}{2}$-in. square and 6 in. long,) to secure the fence rail to pillars ... | | | |
| 1 | 9 | 0 | 14 | In No. 264, straps, (3 ft. long 2 in. × $\frac{1}{2}$-in.) with rounded and screwed ends, 7 in. long for timber bearers of the lower roadway ... | | | |
| | 11 | 3 | 14 | In No. 396, bolts to ditto ($\frac{7}{8}$-in. dr. and 14 in. long) ... | | | |
| | 10 | 2 | 7 | In No. 384, bolts, ($\frac{3}{4}$-in. dr. 22 in. long,) to secure the wood closing piece next expansion joints ... | | | |
| 3 | 19 | 0 | 21 | In small keys, wedges, &c. for fitting the longitudinal and transverse girders, bearers, &c. ... | | | |

*Painting, &c.*

| Yds. | feet | ins. | | £. | s. | d. |
|---|---|---|---|---|---|---|
| 34,700 | | | Sup. Painting at the foundry as described ... | | | |
| | 31,000 | | Run. Bolts ditto ... | | | |
| | 1210 | | „ Rain pipe ... | | | |
| | | | 20 Heads ... | | | |
| | | | 20 Perforated gratings ... | | | |
| | 21,000 | | „ Tye-chains, &c. average 18 in. girt ... | | | |
| 29,000 | | | Sup. Painting twice in oil after the work is fixed ... | | | |
| | 1300 | | Run. Bolts ditto ... | | | |
| | 21,000 | | „ Tye-chains, &c. 18 in. girt average ... | | | |
| | | | Amount to be carried to summary £ | | | |

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Part No. 2.—the two approaches.

*Cast Iron Work.*

| Tons. | cwt. | qrs. | lbs. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| 440 | 19 | 1 | 21 | In No. 268 hollow pillars, No. 1 pattern for ditto, 20 ft. 6 in. long and 14 in. sq., with ornamental bases, (cast on each face) ... | | | |
| 143 | 12 | 1 | 0 | In No. 288, bracing frames between ditto, (as to the arches) ... | | | |
| | | | | No. 3, patterns for ditto, average 6 ft. 2ih. by 4 ft. 0 in ... | | | |
| 84 | 17 | 0 | 21 | In longitudinal bearers over pillars ... | | | |
| | | | | No. 2, patterns for ditto, 20 ft. 0 in. long | | | |
| 68 | 1 | 2 | 7 | In longitudinal girders for curved roadway ... | | | |
| | | | | No. 4, patterns for ditto, with pannelled soffits, about 20 ft. 0 in. long each ... | | | |
| 210 | 0 | 0 | 0 | In No. 50, transverse girders, (as to the arches) ... | | | |
| 80 | 12 | 3 | 0 | In transverse girder under curved roadway ... | | | |
| | | | | No. 1, pattern for ditto, as sketch, 37·6 long, with pockets cast on each side for timber ... | | | |
| | | | | No. 2, patterns ditto ditto ditto, average 10 ft. 0 in. long... | | | |
| 1 | 16 | 0 | 0 | In No. 18, cast iron shoes for end of longitudinal bearers, built in masonry | | | |
| | | | | No. 1, pattern for ditto ... | | | |
| 1 | 16 | 1 | 0 | In plain closing plate, fitted in between transverse girder of upper roadway, next curved plant ... | | | |
| | | | | No. 1, pattern for plate, 8 ft. 7 in. long and 18 in. deep ... | | | |
| 24 | 18 | 2 | 14 | In cornice (as to arches)... | | | |
| 26 | 7 | 0 | 21 | In cornice (curved on plan) ... | | | |
| | | | | No. 2, patterns for ditto... | | | |
| | | | | No. 2, ditto ditto, mitred around pier ... | | | |
| 11 | 0 | 1 | 21 | In closing plate at back of cornice, forming trough gutter, (as to the arches)... | | | |
| 11 | 8 | 3 | 7 | In ditto ditto, (curved on plan)... | | | |
| | | | | No. 2, pattern for ditto ... | | | |
| 23 | 17 | 2 | 7 | In No. 92, hollow pedestals to upper parapet, (as to arches) ... | | | |
| 22 | 6 | 3 | 0 | In No. 48, bays of ballustrade railing to upper roadway, (as to arches) ... | | | |
| 23 | 10 | 0 | 7 | In No. 48, bays of ditto, curved on plan | | | |
| | | | | No. 3, patterns for ditto... | | | |
| 35 | 6 | 1 | 21 | In No. 80, bays of ballustrade railing to lower roadway, (as to arches)... | | | |
| 22 | 4 | 3 | 14 | In No. 48, bays of ditto, (curved on plan) ... | | | |
| | | | | No. 3, patterns for ditto... | | | |
| 7 | 3 | 3 | 0 | In moulded capping, grooved and screwed on upper balustrade railing, (as to arches)... | | | |

| Tons. | cwt. | qrs. | lbs. | | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| 7 | 11 | 2 | 14 | In ditto ditto, (curved on plan)... ... | | | |
| | | | | No. 2, patterns mitred round pedestals... | | | |
| 8 | 19 | 0 | 0 | In moulded capping, grooved and screwed on lower ballustrade railing, (as to arches)... ... ... ... ... ... | | | |
| 5 | 14 | 3 | 21 | In moulded capping as last, curved on plan ... ... ... ... ... | | | |
| | | | | No. 2, patterns about 8′-9″ long... ... | | | |
| 20 | 18 | 3 | 14 | In trough gutter, for lower roadway, (as to arches) ... ... ... ... | | | |
| 5 | 3 | 3 | 0 | In hollow pipes, as fence rail between pillars, (as to arches) ... ... ... | | | |
| | 5 | 1 | 0 | In No. 52, washers for bolts ... ... | | | |
| | | | | No. 1, pattern for ditto ... ... ... | | | |

| Feet | Inches | | | | |
|---|---|---|---|---|---|
| 720 | 0 | Run. 4 in. cast-iron rain pipe, and fixing as before ... ... ... ... | | | |
| | | No. 24, heads to ditto ... ... ... | | | |
| | | No. 24, perforated grating over ditto... | | | |
| | | Running No. 432, bolts into stone, with lead, (2 lbs. to each) ... ... ... | | | |
| | | „ 160, ditto (3 lbs. each) | | | |
| | | „ 128, bays of ballustrade railing into stone, with lead, (23 lbs. each) ... ... ... ... ... | | | |
| | | Drilling 104 holes for 1¼-in. bolt through stone, 15″ thick ... ... ... | | | |
| | | „ 432 holes for ditto, 12″ deep in stone ... ... ... ... ... | | | |

*Wrought Iron.*

| Tons. | cwt. | qrs. | lbs. | | | | |
|---|---|---|---|---|---|---|---|
| | 19 | 2 | 0 | In No. 52, bolts (1½″ dr. 10′-3″ long,) to hold down pillars ... ... ... | | | |
| | 1 | 0 | 14 | In nuts and cotters to ditto ... ... | | | |
| 1 | 5 | 3 | 14 | In No. 432, jagged bolts, 1¼ dr. 12″ long to secure pillars to stone base, including nuts, &c., ... ... ... | | | |
| 2 | 14 | 0 | 21 | In No. 2920, bolts (⅞″ dr., and 5″ long) to secure braces to pillars, including heads, nuts, &c. ... ... ... | | | |
| 1 | 3 | 0 | 7 | In No. 528, bolts, (1¼ dr. 8″ long) to secure the longitudinal bearers of upper roadway to each other ... ... | | | |
| | 19 | 1 | 7 | In No. 536, bolts, (1¼ dr. 5½″ long,) to secure longitudinal bearers to pillars | | | |
| 1 | 1 | 1 | 7 | In 592, bolts, (1¼ dr. 5½″ long,) to secure the transverse bearers to the longitudinal bearers ... ... ... ... | | | |
| 1 | 3 | 0 | 21 | In No. 2592, bolts, (¾ dr., and 3″ long, to cornices ... ... ... ... ... | | | |
| | 4 | 0 | 7 | In 360 bolts, (⅞ dr. and 4″ long,) with heads countersunk to secure cornice to transverse girders ... ... ... | | | |
| | 6 | 3 | 21 | In No. 368, bolts, (inch dr., and 4″ long,) to secure pedestals to girders... ... | | | |
| | 4 | 1 | 21 | In No. 384, bolts, (¾ dr. and 7″ long,) with heads countersunk to secure railing to cornice ... ... ... ... | | | |
| | 8 | 2 | 21 | In No. 244, bolts, (⅞ dr. and 18″ long,) to secure railing to pillars ... ... | | | |
| | 1 | 3 | 21 | In No. 896, screw pins, (⅝″ dr. and 2″ long,) to capping ... ... ... | | | |
| | | 3 | 0 | In No. 200 cotters, to secure fence rail to pillars, (each 6″ long and ½ square) | | | |
| 1 | 10 | 2 | 0 | In small wedges for fitting girders, &c. | | | |

*Painting.*

| Yds. | Ft. | In. | | | | |
|---|---|---|---|---|---|---|
| 15300 | 0 | 0 | Sup. painting, at the foundry as described ... ... ... ... ... ... | | | |
| 6900 | 0 | | Run. Bolts, &c. ... ... ... ... | | | |
| 720 | 0 | | „ Rain Pipe ... ... ... ... | | | |
| | | | No. 24, heads to ditto ... ... ... | | | |
| | | | 24, perforated gratings ... ... | | | |
| 12300 | | | Sup. painting twice in oil, after the work is fixed... ... ... ... ... | | | |

To be carried to summary ... ... £

PART No. 3.—ROADWAYS, &c.

*The Two Approaches.*

| Sqres. | feet | ins. | | | £. | s. | d. |
|---|---|---|---|---|---|---|---|
| | 685 | | Cube. | Memel fir bearers, wrought on three sides, and chamfered two edges, in lengths of 8 ft. 7 in. each 12 ft. 6 in. the ends fitted into iron shoes with white lead ... ... | | | |
| | 4112 | | „ | Ditto ditto as last (in lengths of 8 ft. 7 in. each 12 ft. × 12 in.) and do. do. ... | | | |
| 254 | | | Sup. | Two courses of planking (each 3 in. thick) wrought on the underside, spiked to bearers under as described, each course laid diagonally; all the joints ploughed and tongued, with hoop iron tongues, and all the joints of the upper course to be caulked ... ... ... ... | | | |
| Yds. | | | | | | | |
| 2823 | | | „ | Thick layer of Borrodail's patent felt, No. 2, saturated with tar and pitch, and laid between the courses of planking ... | | | |

*The Arehes.*

| Sqres. | feet | ins. | | | | | |
|---|---|---|---|---|---|---|---|
| | 1942 | | Cube. | Memel fir bearers for footway of lower road, (rough) in lengths of 7 ft. 2 in. each, 12 ft. × 6 ft and the ends fitted as before | | | |
| | 205 | | „ | Ditto for carriage-way, as last (in lengths of 21 ft. 6 in. each 12 ft. × 6 ft. ... ... | | | |
| | 6372 | | „ | Ditto ditto as last (in lengths of 21 ft. 6 in. each 14 ft. × 12 ft.) ... ... ... | | | |
| | 818 | | „ | Ditto filling in pieces, (in lengths of 7 ft. 2 in. each 6 ft. × 5¼ ft.) ... ... | | | |
| | 713 | | „ | Memel fir bearer for upper roadway, wrought on three sides, and chamfered two edges (in lengths of 8 ft. 7 in. each 12 ft. × 6 ft.) the ends fitted as before ... | | | |
| | 4275 | | „ | Ditto ditto as last (in lengths of 8 ft. 7 in. each 12 ft. × 12 ft.) and ditto ditto | | | |
| 161 | 50 | | Sup. | Two courses of planking, (each 3 in. thick,) rough for carriage road, spiked down and ploughed and tongued as before described | | | |
| 280 | 50 | | „ | Two courses of planking, for upper roadway, wrought on the underside, &c. as before described ... ... ... | | | |
| 60 | 75 | | Sup. | Two course of planking, rough for footways, each course 2 in. thick, crossing each other at right angles securely spiked down ... ... ... ... ... | | | |
| Yds. | feet | ins. | | | | | |
| 1795 | | | Sup. | Wood paving 6 in. thick of the metropolitan paving company "Prossers patent," laid complete ... ... ... ... ... | | | |
| | | | | No. 1120, loads of timber and planking prepared according to Payne's patent process ... ... ... ... ... | | | |
| 5586 | | | Sup. | Thick layer of Borrodaile's patent felt, as before ... ... ... ... ... | | | |
| 6114 | | | „ | Painting the underside of planking and timber bearers four times in oil... ... | | | |

Amount to be carried to summary ... ... £

PART No. 4.—LAYING PERMANENT WAY, &c.

| Yds. | feet | ins. | | | £. | s. | d. |
|---|---|---|---|---|---|---|---|
| 1353 | | | Run. | Laying single line of way consisting of two lines of rails, including fixing the chairs, strengthening the rails, &c., and carriage of rails and chairs from the Gateshead station. ... ... ... ... ... | | | |
| | | | | Provide No. 2706, keys to secure the rails into chairs, made of well seasoned, compressed oak or elm ... ... ... ... | | | |
| | | | | „ No. 5412, wrought iron pins to secure the chairs to the blockings under ... ... | | | |
| | | | | „ No. 2706, oak blockings under chairs 12 in. square, secured with four spikes 7½ in. long, and ⅝ in. square to each ... ... | | | |

Amount to be carried to summary ... £

Part No. 5.—contingencies and provision.

£. s. d.

The contractor is to include all tools, labour, implements, carriage, machinery and tackle, and all centering, scaffolding, staying, temporary roads or railways, as well as all other material or labour that may be required for the due performance and perfect completion of the works, whether the same be particularly named or not. ... ... ...

The attention of the contractor is particularly directed to the specification for the mode, and manner of fitting and fixing the several parts, and also, for the description of material ... ... ... ... ... ... ...

The contractor is to set out one half of an arch full size, at his own expence, as described, fol. 20. ... ... ...

The contractor is to fit and erect every arch, and the same is to be tested at the contractor's expense as described, folio 20 and 21. ... ... ... ... ... ...

The contractor will be required to provide two centerings, with the needful tackle aud appendages, should the engineer deem it necessary, as described, fol. 22 ... ... ...

The contractor is to guarantee the stability of the whole, and every part of the work, and to keep the whole in repair for 12 months after the opening of the bridge as described, fol. 25 and 26 ... ... ... ... ... ...

The contractor is to employ competent foremen and watchmen as described, fol. 26 ... ... ... ...

The contractor is to make such working drawings as he may require at his own expense ... ... ... ...

The contractor is to enter into a bond with two sureties subject to the approval of the directors, for the due fulfilment of the contract ... ... ... ... ...

The company's solicitor will prepare the indenture of contract and bond, but the contractor will be required to pay for the stamps and all other expenses attending the same ... ... ... ... ... ... ... ...

The engineer to have full power of making experiments at the contractors expense as described, fol. 31 ... ...

The contractor must include the sum of £2800, for gas lighting, and for any additional works that may be required, such works to be valued according to the prices in the schedule annexed to the tender ... ... ... ...

Amount to be carried to summary ... ... £

*Summary of Bills.*

| | £. | s. | d. |
|---|---|---|---|
| Part No. 1. Iron work to the six arches ... ... ... | | | |
| 2. Ditto to the two approaches ... ... | | | |
| 3. Planking, timber, &c. for the roadways ... | | | |
| 4. Laying permanent way, &c. ... ... ... | | | |
| 5. Contingencies and provision ... ... ... | | | |
| Surveyors charge for the quantities to be paid by the successful competitor, by a bill at three months date, on the day the tender is accepted, $\frac{1}{2}$ per cent. on the amount of the tender ... ... ... ... ... ... ... | | | |
| Total amount of Tender ... ... £ | | | |

The tenders to be delivered in York, on Monday, the 17th August, at 10 o'Clock.

## Art. III.—Iron Clipper Schooner, "Prince of Wales."

We subjoin the specification of an Iron Clipper Schooner, built by Messrs. Wm. Simpson and Co., York-place Engine Works, Aberdeen, for the Old London and Leith Shipping Company. This vessel has sailed between London and Leith for a considerable time and in all weathers; and Captain Jordan, her experienced commander, who has sailed her from the first, speaks in the highest terms of her performance, both as regards her speed, and her easiness and security in a sea.

| | | |
|---|---|---|
| Length of Keel ... ... ... | 83 ft. | 0 in. |
| Fore-rake ... ... ... ... | 15 | 0 |
| Extreme Breadth ... ... ... | 22 | 4 |
| Depth of Hold ... ... ... | 12 | 6 |

*Keel.*—Of best scrap iron 5 × $1\frac{1}{2}$ in., forged in as long lengths as possible; to have two tiers of 13-16 in. holes. Scarphs 15 in. long.

*Stem.*—Of best scrap iron 2 in. thick by 4 in. broad at top, and 2 × 6 in. broad at keel, with 3 or 4 ft. of it kneed to form the keel, and scarphed to keel with 18 in. scarphs; to have two tiers of holes, and planed on each side to receive the ends of plates.

*Stern Post.*—Of best scrap iron 2 in × 4 in. broad at top, and 2 × 6 in. broad at bottom, and kneed so as to form 3 or 4 ft. of the keel and scarphed to keel; to have two tiers of holes.

*Frames.*—Of angle iron $3\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8}$ in. placcd at 2 ft. from centre to centre to go up to main rail.

*Plates.*—Garboard strake $\frac{5}{8}$ in. thick, from that to 6 ft. water line $\frac{3}{8}$ in. thick; from 6 ft. water line to 10 ft. water line 5-16 in. thick; from 10 ft. water line to gunwale $\frac{1}{4}$ in. thick; clinker built with flush butts and countersunk rivets flush, all of best Staffordshire iron.

*Rivets.*—Of best Lowmoor iron 13-16 in. in keel, stem, and stern-post, to be double rivetted as high as 6 ft. water line with $\frac{3}{4}$ in. rivets hammered flush; from 6 ft. water line to gunwale, single rivstted to 10 ft. water line with $\frac{3}{4}$ in. rivets, and the next with $\frac{5}{8}$ in. rivets; the whole of the outside rivets to be countersunk and hammered flush. Floor, beam, and stringer rivets to be $\frac{5}{8}$ in. except where it may be thought necessary to make larger or smaller.

*Floors.*—Of plates $\frac{1}{4}$ in. thick 14 in. deep, one on every frame for 40 ft. in midships, the remainder at every intermediate frame with $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$ in. angle iron at top edge running up on frames.

*Keelsons.*—To have three rows of keelsons of $\frac{1}{4}$ in. plates running fore and aft, so far as the vessel will admit, the centre one at keel and the side ones at a proper distance from the keel—to be $2\frac{1}{2}$ in. above the floors with $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$ in. angle iron back to back on each side of top edge.

*Main-Deck Beams.*—To be of ⊤ iron $5 \times 4\frac{1}{2} \times 2$ in. and $\frac{1}{2}$ in. thick, one on every second frame, except the mast beams, where there must be one on each frame, that is one on each side of fore and main-mast, and bound together with fore and afters every 4 feet. The whole of the beams to be secured to frames with triangular knees 5-16 plates, cabin and forecastle sole beams to be the same as main deck, and fastened in same manner.

*Hold Beams.*—To have two in the body of the vessel of round iron 3 in. diameter, being made up square at the ends so as they may be keyed into the diagonal iron braces, securely attached to the sides of the vessel.

*Stringers.*—Main-deck stringers of plates 15 in. broad by $\frac{3}{8}$ in. thick, secured to the hull of the vessel by flanging, and to beams with four rivets in each beam-end.

*Breast-hooks.*—Formed of plates and angle iron in strength and number as may be thought necessary for the proper binding of the vessel.

*Stern Timbers.*—Of plates 6 in. broad by $\frac{1}{4}$ in. thick, with $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{4}$ in. angle iron on outer edge, and properly secured to hull of vessel with $\frac{3}{4}$ in. rivets.

*Carlings.*—Main-deck carlings and fore and afters same size and strength as beams, except through hatchways, windlass, and mast. Fore and afters to have angle iron on top and lower edge $3\frac{1}{2} \times 3\frac{1}{2} \times \frac{3}{8}$ in.

*Rail Stringers.*—Of angle iron $3\frac{1}{2} \times 3\frac{1}{2}$ in. secured to bulwark plates and frames with $\frac{5}{8}$ in. rivets, with holes on top sides for screwing down main-rail.

*Rudder-Stock, &c.*—Of best hammered iron $3\frac{1}{2}$ in. diameter to where back starts off, below that 4 in. broad by $2\frac{3}{8}$ in. thick, and plated with 3-16 in. plates and secured with 4 malleable iron bands. Mahogany wheel with brass mounting, standard, blocks, and chains complete.

*Bulk-heads.*—To have two water-tight bulk-heads of iron 3-16 in. thick from keel to gunwale, and stiffened with $2\frac{1}{2} \times 2\frac{1}{2}$ in. angle iron, one of them to form the cabin bulk-head, with one water tank either in fore or after peak.

*Timber-heads.*—Of British oak placed where required, to be $6 \times 4\frac{1}{2}$ in. fastened to hull with $\frac{3}{4}$ in. screw bolts.

*Stern Plank.*—Of red pine $2\frac{1}{4}$ in. thick, and secured with $\frac{1}{2}$ in. screw bolts, and to be made tight with white lead, quarter-pieces of hard wood.

*Hawse Pipes.*—Secured in a proper manner either with wood or iron.

*Waterways.*—Of red pine 12 in. broad by $4\frac{1}{4}$ in. thick, made watcr-tight with felt, and secured to hull and stringers with $\frac{5}{8}$ in screw bolts.

*Deck Plank.*—Of yellow pine 6 in. broad by 3 in. thick and screwed to beams with deck-screws of sufficicnt length; to be well caulked, pitched, and planed both below and above. Cabin and forecastle decks of yellow pine 2 in. thick, and secured same as main deck.

*Paul-Bitt.*—Windlass-bitts, hawse-pipe, bowsprit-bitts, &c. of sufficient strength and size, fitted up with all the necessary gearing complete; belaying-cleats either of wood or iron, fitted on where required.

*Windlass.*—Windlass with patent purchase.

*Flooring and Ceiling.*—Flooring of American elm $2\frac{1}{2}$ in. thick, to run up on side of vessel 3 ft. above floors, and secured with deck-screws. Ceiling of red pine $1\frac{3}{4}$ in. thick to go up to main-deck, and secured in same manner as high as upper part of bilge; above that to be nailed to hard-wood bolted to frames.

*Rails.*—Main-rail of American elm 9 in. broad by 3 in. thick, securely bolted down to top of angle iron with $\frac{5}{8}$ in. bolts. Inside ceiling of bulwarks of yellow pine $1\frac{1}{4}$ in. thick, except one stroke next the rail and one next the water-ways to be of $1\frac{3}{4}$ in. secured to wood screwed to frames. The rails and bulwark ceiling to be made completely water-tight. Taffrail same thickness as main-rail, and as broad as may be required.

*Coamings.*—Of oak $4\frac{1}{2}$ in. thick by 12 in. broad, securely bolted down to beams with $\frac{7}{8}$in. screw-bolts. Hatches framed with elm and clad with $1\frac{1}{4}$in. yellow pine.

*Cabin and Forecastle*.—To have one companion and one skylight to cabin, with a sufficient number of sleeping berths and lockers.

Cook-house, one boat with four oars and davits.

*Masts and Spars*.—To be of red wood of sufficient size, to have English oak cheeks free of sap, laid with white lead. Bowsprit to be 16in. at head. Jibboom $9\frac{1}{2}$in., fore-topmast 10in., main-topmast $6\frac{1}{2}$in., main-boom 10in., fore-yard 10in., topsail-yard 8in., and others in proportion—all of east country growth.

*Head*.—To have a neat figure-head, and carved mouldings on stern, with a star on each quarter.

*Lead*.—To have two scuppers on each side $3\frac{1}{2}$in. broad by $1\frac{1}{2}$in. deep, the stem to be lined with 5lb lead and copper-nailed, the stern the same; the cabin-stove-berth to be lined with 3lb lead and a strip to be nailed all round the edge of both soles.

And it is understood that the builders are to find all carpenter and joiner work about the hull and spars, and all other tradesmens' work, such as iron for rigging, blockmakers, painter, plumber or glazier work, including two pumps and pump-gear, caboose, water-closet, and ship-chandlery articles, including a proper suit of colours, and the common necessary cooper-work, viz. a watercask 60 gallons, two harnass beef-tubs, six buckets, one draw-bucket, four mess-kits, one water-funnel, and one buoy. To have a patent winch.

*Cordage*.—The vessel to be fitted out complete for sea with one set of standing and running rigging, with four shrouds on each mast, and of the following sizes made from best Riga or Polish Rhine hemp made into small yarns, to be of patent manufacture for a shooner rig.

| | | |
|---|---|---|
| Forestay ... ... ... ... ... | 8 in. | |
| Fore-shrouds ... ... ... ... | 6 | |
| Fore-topmast shroud ... ... ... | $3\frac{1}{2}$ | |
| Mainstay ... ... ... ... ... | 5 | |
| Main-shrouds ... ... ... ... | $5\frac{1}{2}$ | |
| Main-topmast shrouds ... ... ... | 3 | |
| Lanyards for lower rigging ... ... | $2\frac{3}{4}$ | |
| One warp ... ... ... ... | 4 | 100fms. |
| One do. ... ... ... ... ... | 5 | 100 „ |
| One do. ... ... ... ... ... | $6\frac{1}{2}$ | 70 „ |

*Sails*.—To have a complete suit of sails of the best sail-cloth, and of the following numbers:—

Mainsail No. 1 brown, boom-foresail No. 1, stay-foresail No. 2, topsail No. 3, top-gallant-sail No. 5, jib gaff-top-sail and square-sail No. 5, two lower studding-sail topmast ditto, No. 6, top-gallant-sail ditto No. 7, mast coats, cover for skylight, two sets of tarpaulings complete, one inner jib No. 5, boiled canvas.

*Chains and Anchors*.—To have two bower anchors one 9cwt. and the other 10 cwt. one stern ditto, and one small kedge all of sufficient size, and well manufactured. To have 160fms. of 1in. chain cable and two $\frac{5}{8}$in. mooring chains 25fms. each, with topsail-tye and sheets with main and fore-haulyards, shank painters and stoppers, bobstay and bowsprit, shroud and gammoning, all to be tested to the satisfaction of any competent judge, and whatever may be omitted in this specification to be done in proportion to the other parts of work, and if any alteration be proposed during the progress of building, the same to be complied with, and if it should cost more, the owners to pay for it in proportion, and if it should cost less, the same to be deducted from the contract price.

The whole work to be executed in a proper workmanlike manner, to the satisfaction of any competent judge.

A water tank to be fitted under the cabin to contain 500 gallons.

The rigging plan to be approved of by the owners.

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## Art. IV.—INSTITUTION OF MECHANICAL ENGINEERS.

A meeting, convened by circular forwarded to the principal mechanical engineers in the kingdom, was held at the Queen's Hotel, Birmingham, on Wednesday, October 7, Mr. Mc. Connell, of the Birmingham and Bristol Railway, in the chair, for the purpose of considering the propriety of establishing s Mechanical Engineers' Association. Amongst the gentlemen present were Mr. Buckle, of the firm of Boulton and Watt, Soho; Mr. Humphreys, Messrs. Rennie's, London; Mr. Beyers, Sharpe, Brothers, and Co., Manchester; Mr. Brown and Mr. Garland, Soho; Mr. Cowper, Fox, Henderson, and Co.; Mr. Slate, Tube Works, Smethwick; Mr. Peacock, Manchester and Sheffield Railway; Mr. Ramsbottam, Manchester and Birmingham Railway; Mr. Dubes, of Laylens and Co.; Mr. Clift, Staffordshire Gas Company; Mr. B. Cubitt, of London, &c. The Chairman, in introducing the business of the meeting, said he felt considerable diffidence in taking such a position at a meeting of so much importance as he thought that would be to the profession of mechanical engineers. He believed it was generally acknowledged that such an institution was much required, and that they were only on the threshold of inventions, which institutions like the proposed one would very much tend to encourage and improve. Independant of that, the object of the promoters was to encourage amongst the different members of the profession a feeling of friendship, to make them acquainted with each other, and, as it were, establish a commonwealth of mechanical intelligence. Resolutions, appointing a committee, and otherwise forwarding the views of the association, were passed, in the course of which a desire was expressed to hear the opinions of Mr. Buckle and Mr. Humphreys.

Mr. Buckle said he had carefully considered the object of that meeting, and he felt every confidence that it was fraught with great and important results. The proposed institution would bring young minds together, and afford great assistance to all those engaged in engineering pursuits. He was also of opinion that it would not affect the parent society, but he was of opinion that both working together would mutually tend to the public good. From the first intimation of the project, he looked forward to that meeting with great pleasure, and he could now assure the gentlemen present he should be most happy, on all future occasions, to further the objects of the institution. He believed that if proper care was observed in carrying out the rules and admitting members, everything good and beneficial might be anticipated from the institution.

Mr. Humphreys said, there could not be a second opinion upon the importance of establishing such an institution amongst mechanical engineers, and he also looked forward to most beneficial results from a spirited adherence to their present intentions. The meeting then separated, and the gentlemen who attended it dined together in the evening, Mr. Mc.Connell occupying the chair, and Mr. Buckle officiating as vice-chairman. The cloth having been removed, and the usual loyal toasts given and responded to. The Chairman rose to propose the toast of the evening, "Success and prosperity to the Mechanical Engineering Institution," and in doing so said:—Having already at their meeting briefly noticed the object for which they were assembled, it would not be necessary that he should go at much further length into the subject, but he might observe that in that, as well as every other large and comprehensive scheme of improvement, a very heavy and great responsibility rested upon those with whom it originated. They would have to provide for the intellectual mind of all who felt anxious to improve their knowledge in mechanical science. They would have to lay down principles for the establishment of an institution of the most liberal, impartial, and independent character—they would have to promote, by every means in their power, that unity of action—that cordiality of feeling and determination of purpose necessary, in spite of all obstacles, to carry the undertaking to a successful issue. He was sanguine enough to believe that the importance of that undertaking was such as could not fail to command for it the attention and support of all those who felt an interest in forwarding the great movement now going on in the mechanical world; and he trusted they would have the assistance of every man in the kingdom, who knew, as he did, that the foundations of our country's greatness owed its origin to the mechanical skill of our operatives. Coupled with the toast, he could not omit giving the name of a gentleman who had already rendered such substantial services to the undertaking—he alluded to Mr. Slate, the worthy secretary of the institution. The toast having been drunk with enthusiasm,

Mr. Slate responded, and in doing so, said he felt at a loss to express his sense of the honour which had been done him in joining his name with so valuable an institution. The want of such an association for kindred minds had long been acknowledged and regretted by himself and others engaged in mechanical pursuits, and he hoped the time had now arrived when this great desideratum would be fully supplied. Many most important improvements in different branches of mechanical invention now only wanted the fostering care and united experience of men likely to compose that society. He was glad to find they had already secured the co-operation of men such as he then saw around him—men eminent in their profession, and who had already conferred such decided advantages upon the profession to which they belonged, and the highly important and influential houses they represented. When he saw such men as Mr. Buckle, manager of Boulton and Watt's manufactory, the birth-place of the modern steam-engine, and the oldest of the engine-making establishments in the world—when he saw Mr. Humphreys, manager of Messrs. Rennie, of London, representing the proprietors of a house which, from the time it was founded by the late Mr. Rennie the worthy coadjutor of Mr. James Watt, still retained its high celebrity—when he saw Mr. Beyers, the manager of Sharps, Brothers, of Manchester, from whose establishment had issued the most excellent specimens of mechanical genius in the manufacture of locomotive engines and cotton machinery, he felt satisfied that enough had been shewn to justify the truth of this statement. Mr. Slate concluded by saying, that the *prestige* of success, the materials for erecting that superstructure of mechanical talents were already in their hands, and he trusted the opportunity afforded of effecting so much good would not be neglected.

The Chairman again rose to propose "The Institution of Civil Engineers, and prosperity to it," and in doing so took the opportunity to observe that as a member of that institution, he felt sincerely anxious for its continual success, but he stood there in another position—as a promoter of an institution which, although similar in its objects, was intended to embrace in a more comprehensive manner the cultivation of one particular branch. Having already disclamed all intention of other than the most honourable rivalry, that of doing good, he could, with the most perfect sincerity, propose "Success and prosperity to the Parent Institution, coupled with the health of Mr. Cubitt, a distinguished member of their body."

Mr. Cubitt, on rising to reply, said that he was fully sensible of the honour they had done him in connecting his name with the Institution of Civil Engineers, an institution so much appreciated and well known for the extent of its provisions for the improvement of its members and he felt certain they would hail the establishment of an institntion like that, which he had then the honour of addressing with great pleasure For himself, he esteemed it an honour to be connected with the Institution of Mechanical Engineers.

The Chairman next proposed "The memory of James Watt," and in doing so, said he never mentioned the name of Watt without feeling a species of enthusiasm, in doing honour to the memory of a man who had conferred such substantial and lasting benefits upon the whole human race—a man whose untutored original genius had produced a power which enabled Great Britain to become the workshop of, and challenge competition with, the world.

Mr. Buckle, in responding to the toast, said he never could hear the name of an old and esteemed master mentioned without feelings of gratitude and respect. He had now been connected with the establishment of Boulton and Watt nearly thirty years, and he felt his connexion with that house to be an honour and a constant source of gratification and pride. The memory of James Watt would be cherished by every mechanic, and he felt certain no word of his could express the esteem and veneration with which every member of the Soho establishment remembered the name of that illustrious man. In conclusion he begged to propose "The establishment of Mr. Rennie."

Mr. Humphreys returned thanks, and said he felt deeply honoured by the compliment paid to the celebrated house with which he was connected. He should be most happy to render all the aid in his power to carry out the objects of the infant institution.

The Chairman next proposed "The Locomotive Manufactories of Great Britain, coupled with the name of Mr. Beyers, of Sharp, Brothers, of Manchester."

Mr. Beyers returned thanks, observing, that he was quite unable to acknowledge the toast in suitable terms. He felt proud at being connected with a body of men so distinguished as those who were likely to compose the Institution of Mechanical Engineers. He, as a foreigner, had always looked upon England with great respect, and he anxiously longed to come to this country. When he joined the establishment in Manchester; he had some difficulty to contend with, and was then only a working man, but now he might say he held a high and proud position in that establishment. He looked upon every locomotive engine that left that manufactory as an agent for the spread of intelligence and civilization. Railways might now be acknowledged as the most effective means of uniting mens' minds, removing all the old-world prejudices, and giving an impetus to improvement tending to benefit and increase the knowledge of mankind.

The Chairman next proposed "The Liberty of the Press" as a powerful engine for the spread of human intellegence, the destroyer of tyranny, ignorance, and superstition, the great schoolmaster of reason, and universal medium of education.

Mr. Maher responded to the toast. The Chairman, after the lapse of a few minutes, said that he was sure no apology was necessary in proposing the health of the most distinguished living engineer, and when he uttered the name of George Stephenson, he was sure it was a toast which would meet with the most hearty response from all present. To him was assigned, by unanimous public award, the title of "Father of Railways." To him they owed the introduction of that splendid scheme of intercommunication not only in this country, but throughout the world. To him, for the improvement in the locomotive engine, they were indebted for the comparative annihilation of time and space; and when they were told that this man from a humble mechanic had raised himself to a position which kings or emperors might envy, they must feel that no honours they should pay him were at all commensurate with his merits. The Chairman next proposed the health of Mr. Robert Stephenson, who was the worthy son of a worthy sire, who inherited his father's genius, and whose kindness of disposition, knowledge, and gentlemanly bearing had won for him the highest respect of all who had the pleasure of his acquaintance. The toast was received with applause.

The Chairman, on rising to propose the next toast, said he desired now to pay a compliment to a body of men whose enterprize, skill, and intelligence could not have been produced in any other country in the world, and which had never been witnessed, and never perhaps could be excelled, through whose persevering determination a net-work of railways, of the most expensive and difficult description, had been framed and brought into successful operation in this country, by whom the successful employment of nearly one hundred million of money had been brought into active opera- tion in transporting our people and their commodities from one end of the country to the other; he need not say he alluded to the Railway Directors of Great Britain.

Mr. Sanders, secretary of the Birmingham and Bristol Company, on being called upon, responded to the toast. He said he felt certain the directors of his own as well as of other companies in the kingdom were fairly entitled to the high meed of praise which had been bestowed upon him by the Chairman, and on the part of his own directors, he begged to say that their liberality of feeling and commercial enterprize would fairly warrant him in assuring the members of the institution that every facility would be given to encourage their new undertaking, and, so far as his influence was of service in procuring accommodation to the members in assembling at their periodical meetings, it should be cheerfully granted. He regretted that evening that he had not been a scientific man, that he might have become a member of their body. He would feel favoured if they admitted honorary members, by being permitted to add his name to the list.

Mr. Clift proposed the health of Mr. Brunel, and, in doing so, paid a well-merited compliment to that distinguished man.

The toast was received with applause, after which the healths of the Chairman and Vice-Chairman were drunk and responded to, and the company separated at an early hour.

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## Art. V.—THE "BULL DOG" STEAM FRIGATE.

Some of the penny-a-liners of the *Times* have lately been exercising their ingenuity in attributing various faults to the machinery of this vessel, which have, in reality, no existence; and although the strictures of those industrious persons are of so transparent a character that their ignorance and captiousness pretty clearly shine through, we have thought it right to make some enquiry upon the subject with the view of ascertaining whether there was any foundation whatever for the complaints referred to. The result of this enquiry has been to shew, that every part of the machinery is in the most perfect order, and has acted and answered well; but the after-firing-space is inconveniently hot, although the engine-room is perfectly cool. The cause of the inconvenient heat of the aftermost firing-space is traceable to the insufficient dimensions of the deck hatches, which, as in many of the government vessels, are made too small to permit an effectual ventilation; and the remedy lies in the hands of the ship-carpenter, and not in those of the engineer. At the same time the heat of the aftermost firing-space is not greater than it is in many other vessels; but wherever it exists it is a defect, and should be remedied by those who have the power in their hands, though, as it affects chiefly so trivial a thing as the comfort of the firemen, we hardly expect that in the navy it will receive much consideration.

The engines of the *Bull Dog* were constructed by Messrs. Rennie, and they add credit even to their high and increasing reputation. The cylinders are of 83 in. diameter, and 5 ft. 8 in. stroke, and with a mean pressure of steam of 2·7 lbs. the mean vacuum was 11·35 lbs., and the number of strokes 24 per minute. The engines are furnished with disconnecting gear of the kind known as Braithwaite's, wherein a strap, to which the crank-pin is attached, encircles a metal disc fixed on the shaft, and by tightening a key, the shaft is carried round by the friction.

We subjoin a letter from the engineer of the *Bull Dog*, by which it will be seen that the performance of the engines has been satisfactory in every respect.

"Plymouth, Sept. 24th, 1846.

Sir.—We have just arrived in Plymouth all right. We left Spithead at 10 minutes past 1 p.m., yesterday morning, against a strong head wind and heavy sea. After we got outside of the Needles we were obliged to stop and tighten up the disc cranks; as soon as we got into a sea-way they began to slip, we were obliged to go half speed, and stop again; we drove the keys a good inch and a half farther through, and then went on again; after this the wind and sea increased, but the cranks held good. The ship on her passage by change of wind and cross seas had an excellent chance of trying her machinery by pitching and rolling heavy. I examined the frame work when she was rolling heavy, but no motion was perceptible. The engines kept their speed up, and worked admirably well against a heavy sea and strong head wind, never falling short of 14 and 15 revolutions when the stokers kept the steam steady at 6 lbs.. and not less than 12 revolutions at the worst of times, never hanging on the centres. The speed of the vessel 6 and 7 knots, in such weather as I am certain I have seen other vessels of the same magnitude and power would not have exceeded 4 knots. We arrived inside of the Harbour at 9 a.m. this morning, making the passage in 20 hours, including three stoppages from Spithead. Mr. Murray went out to Spithead with us, and he expressed a wish for me to examine the brine valves, and to put in the new ring, and get up steam and see that all was right before I left. I am now busy examining the valves: I expect they will want a little extra weight on them, which can be done by putting a few cast-iron washers on the old weights."

Yours obediently,

Wm. Chicken."

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## Art. VI.—HIGHTON'S ELECTRIC TELEGRAPH.

An improvement in Electric Telegraphs has lately been patented by Mr. Highton, of Rugby, and purchased by the Electric Telegraph Company, (the present proprietors of Cooke and Wheatstone's patents,) which is likely to prove of considerable importance in telegraphic communication.

The improvement consists mainly in the substitution of a slip of metallic leaf, with a magnet placed near it, for the old coil of wire and magnetic needles.

The advantages gained by this change are many and great.

1st. Its cheapness.—A couple of coils and needles, &c. such as are at present used, cost 20*l.*; whereas, the corresponding apparatus, on the new plan, does not cost more than 20*s.*—a difference of 1900 per cent.

2nd. In delicacy.—With the new apparatus, a battery of a single cell will work through 100 miles of wire. This gives many collateral advantages. For instance, it may be employed with great advantage in derived circuits. Thus, dividing the current in two or more parts, the same news may be transmitted direct from Liverpool to London, while at the very same time the same fluid is travelling through two derived circuits, and conveying the same information through Bristol on the one side, and Cambridge and York on the other.

3rd. The greater rapidity of motion.—Gold leaf being almost without weight, and consequently without momentum—immediately after the signal is made, the leaf drops dead down without oscillation or swinging, which always takes place more or less in the needles.

4th. By a slight change in the construction of the keys or handles which serve as commutators, double or even treble the number of signals may be made with each slip of gold leaf to what can be made with the needles. With a needle, in consequence of its oscillation, only one power of electricity can be employed, whereas, with the gold leaf, two or threc different powers may be employed, deflecting the gold leaf to a less or greater extent, and consequently multiplying in a corresponding ratio, the number of different signals given.

5th. The portability.—One of the gold leaf apparatus may be carried about in the pocket, and applied to use for any temporary purpose at any point of the country in the course of a minute or two.

6th. In consequence of the cheap and simple nature of the apparatus, a large reservc may be always kcpt ready for use at each station, so that if one apparatus be damaged by lightning or other cause, another may be substituted for it in a few seconds.

7th. The less resistance offered to the passage of the electric fluid.—Every one of the coils in use at present offers a resistance equivalent to about six miles of wire; whereas, the new instrument is equal to not more than a few hundred yards:—thus, on the new plan, the same message or information may be conveyed through almost any number of stations throughout the country, without making any perceptible difference in the power of the battery required. This facility of multiplying telegraphic stations, may, under many circumstances, be of very great importance.

Having these advantages it must soon entirely supersede the old needle telegraph, and will probably be for the present the form of telegraph used throughout thc world, till it is in its turn superceded by some new invention.

Now that the form of telegraph is reduced to such simplicity, it will probably be used for communication, not only to great distances, but between different parts of the same public buildings, &c. We consider it as a very important step in the history of telegraphic communication.

We hear that the same gentleman and his brother (the Telegraphic Engineer to the "London and North Westcrn Railway Company,") are now engaged in making further experiments, which, we hope, will be attended with as valuable results.

For the further information of our readers, we subjoin the short heads of the specification of the patent itself, togcther with a drawing of the instrument.

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*Specification of the Patent granted to* Henry Highton, *of Rugby, in the County of Warwick, Master of Arts, for Improvements in Electric Telegraphs.*—Sealed February 3, 1846.

"To all to whom these presents shall come, &c., &c.—In the electric telegraphs now commonly used on English railways, signals are given, by the motions of magnetic needles, which are caused to move to either side by the action of electric currents passed in either direction, through coils of wire surrounding magnetic needles. And I have discovered that signals can be exhibited in electric telegraphs by motions produced by electric currents in strips of metallic leaf, suitably placed, in a very cheap form of signal apparatus, resembling a gold leaf galvanometer.

The drawing hereunto annexed represents a signal apparatus, consisting of a glass tube, A, fitted in brass caps, *a, a*, at top and bottom, and having a strip of metallic leaf, B, (gold leaf being the kind of metallic leaf which I usually employ,) passing through its centre, loosely hung, in metallic contact with the said caps; the upper extremity of the metallic leaf being fixed at right angles to its lower end, so that the metallic leaf, from whatever direction seen, will presents at some part its flat surface to the eye. The caps, *a, a*, (which are moveable in order that the metallic leaf may b replaced if broken,) are placed in a circuit suitable for electro-telegraphic communication.

Near to the metallic leaf (as on the outside of the glass) is placed either of the poles of a magnet, C. And thc effect of this arrangement is, that, when a current of voltaic electricity is caused to pass through the circuit, and, therefore, through the metallic leaf, B, included in it, the metallic leaf is deflected to one side or the other, according to the direction of the current. And the distinct motions so obtained may be repeated and combined, and used for the purpose of designating letters or figures, or other conventional signals.

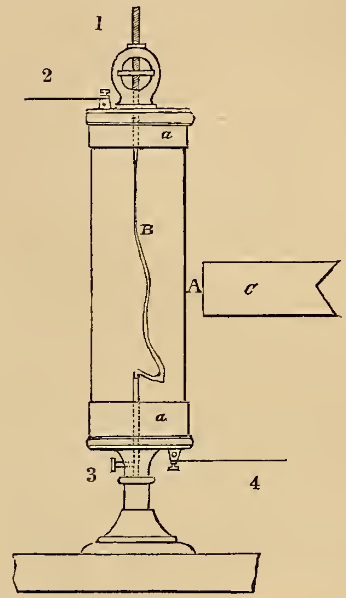


Fig. 1. Screw for Adjustment. Fig. 2. Telegraph Wire.
Fig. 3. Screw for Adjustment. Fig. 4. Telegraph Wire.

One of the above-mentioned signal apparatuses is placed at each terminus of telegraphic communication, and others may be placed at intermediate points.

Each terminus, and also each intcrmediate station, is provided with a voltaic battery and with one of the key-boards in use in single magnetic-needlc electric telegraphs. The person in charge of the telegraph at either terminus, or at any intermediate station, produces the requisite connexions for causing an electric current to pass in either direction through the circuit, and, therefore, through the metallic leaf of the signal apparatus of each terminal or intermediate station, and thus causes the metallic leaf of all the signal apparatuses to move simultaneously to either side, so as to give the required signal or signals.

The key-board of each terminal and intermediate station has a handle, by moving which the person in charge of the telegraph at any station can cause an electric current to pass through a circuit in connexion with a system of alarums at the terminal and intermediate stations, similar to those in use in magnetic-needle electric telegraphs.

Thc method of forming such a system of alarums, and the handles and other arrangements by which the alarums are caused to act, are exactly similar to the corresponding parts and arrangements in the magnetic-needle electric telegraphs, which are well known.

By means of the alarum circuit, and apparatuses so combined with thc signal circuit and apparatus, a message from any station can be preceded or accompanied by audible sounds, so as to attract attention thereto, as is well known.

Having described my invention, and the manner in which the same is to be performed, I would havc it understood that I do not mean to confine myself to the details of my description, if thc principles of my invention be retained. And I would also have it understood that I lay no claim to the use of metallic leaf in galvanometcrs or otherwise than for the purposes of my invention, as herein described.

But what I claim as my invention consists in the following particulars, that is to say—

First, I claim the application of metallic leaf for the giving of signals in electric telegraphs.

Secondly, I claim the combining into one system of electric telegraphs, so as to act together, two or more apparatuses adapted for giving signals at different places by means of metallic leaf; and,

Thirdly, I claim the combining of alarum apparatus in electric telegraphs with apparatus for giving signals by means of metallic leaf."

Henry Highton.

## Art. VII.—HOW TO PRESERVE BOILERS FROM INCRUSTATION.

Sea water contains about 1-33 its weight of salt, and its specific gravity is increased by boiling until it contains 12-33 of salt, which is the point of saturation, and the water will not then hold more salt in solution. As the water is more concentrated, it requires a higher temperature to make it boil. The boiling point of sea water which has 1-33 of salt, is 213.2°; with 2-33, 214.4°; with 3-33, 215.5°; with 4-33, 216.7°; with 5-33, 217.9°; with 6-33, 219°; with 7-33, 220.2°; with 8-33, 221.4°; with 9-33, 222.5°; with 10-33, 223.7°; with 11-13, 224.9°; and saturated water 226°. These are the boiling points in the open air; in a steam boiler, where the pressure of steam is always above the pressure of the atmosphere, the boiling points will be correspondingly higher, but with any uniform pressure of steam in the boiler it is possible to make the thermometer an index of the saltness of the water, If the water be maintained at a concentration of 4-33, or if about one fourth of the water be withdrawn from the boiler by the brine pumps that is forced in by the feed pumps, very little deposit will collect within the boiler. The quantity of fuel wasted by blowing off this quantity of water, cannot, it is clear, be considerable, even with this large amount of blowing off. Of every 4 cubic feet of water entering the boiler from the hot well, 3 passes off in steam and 1 in brine. The temperature of the hot well being 100°, the heat imparted to the water to raise it into steam may be represented by $1112° \times 3 = 3336$, while the heat contained in the brine is 112° or rather less, the specific heat of brine being less than that of fresh water, and $3336 \div 112 = 29$, so that about 1-29th ot the heat passes out in the super-salted water when large blowing off is practised. A much larger quantity of heat than this goes to waste if there be any material accumulation of scale upon the flues, and engineers will therefore see that there is no economy in penurious blowing off. Scale thicker than a sheet of writing paper should never be seen in marine boilcrs; a greater thickness shews that blowing off has not been sufficiently practised, and if the blowing off be performed from the surface of the water as prescribed by Mr. Lamb, in his apparatus we described last month, *no excuse* should be taken for the accumulation of scale. Several letters have come to hand descriptive of the advantages of that apparatus in various vcssels in which it has been tried, to which we may further advert on a future occasion : but it is sufficient to say at present that they uniformly speak of its efficiency and success.

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## Art. VIII.—NOTES OF THE MONTH.

*Greenock Artizan Club.*—An Artizan Club is in course of formation at Greenock, in which Mr. James M. Scott, late manager of Messrs. Scott, Sinclair, and Co.'s works, is the chief mover. Mr. Scott has already established some clubs and other institutions for the use of thc higher classes at Greenock, and indeed the town is much indebted to his public spirit for many ameliorations; but the present scheme, if fully carried into effect, will place his other achievements in the shade, and earn for him thc character of a great public benefactor. The design of the club is to attract mechanics from the public house, by providing them with a superior place of amusement; and if once they can be induced to come together for any purpose other than that of dissipation, the most beneficial results may reasonably be expected. Mechanics' institution s have failed in their object because they are too austere and scientific, and Mr. Scott therefore wisely begins by amusement, as the chief suasory to attendance. Men who go there only for pleasure, may eventually come away with all the benefits of substantial improvement; and many may be insensibly weaned from habits of intemperance which could find no issue but in their utter destruction. The practice of meeting together, moreover, under some of the restraints of decorum, can hardly fail to have a beneficial influence upon the manners and character; and we think this influence would be fortified and extended if the principle of a club were so far carried out as to provide an ordinary for the members, where they might have a plain substantial dinner daily at a very moderate expense. The superior cleanliness and order to which they would thus become accustomed would naturally make them desirous of establishing a corresponding standard in their own homes, and this commendable aspiration would soon becomc the parent of greater virtues. Indeed, it is hard to assign any limit to the bcnefits of the present movement, should the example of Greenock be followed by other places; and the measure being fairly before them we know the working classcs to have sufficient penetration to enable them so far to discern these benefits as to inspire enthusiasm in the cause. Up, then, and be doing :—hear first what Greenock intends to do, and then 'go and do thou likewise.'

"Newspapers and Magazines to the extent of £100 per annum shall be provided, adapted for all religious and political views whatever; but effectual means will be adopted to prevent the intrusion of pecnliar views by any partics in an objectionable manner. All games of skill and chance, such as chess, drafts, backgammon, whist, billiards, bowls, quoits, &c., shall be permitted under such regulations as will effectually prevent gambling. Music, and, in short, every rational amusement that can be suggested by any of its members, shall be encouraged and promoted, subject always to the approval of, and regulations to be made by, the Committee of Management for the time being, No intoxicating liquors shall be admitted upon any pretext whatever. As it is not absolutely necessary to prevent smoking entirely, which might exclude many eligible members, I propose, subject to the approval of the committee, that one room shall be expressly appropriated for smoking only. Suitable premises shall be provided in a central situation; the subscriptions to be for one year, 7*s.* 6*d.*; for half a year, 4*s.*; and for one quarter, 2*s.* 6*d.*, payable weekly, or otherwise, as may be hereafter determined. For the due fulfilment of my intention to establish a club, which shall be creditable to all connected therewith, I rely on the following results:

1. That a committee will be appointed in whom the operatives themselves can have entire confidence, and who will take the same pleasure as myself in its prosperity.

2. That the most intelligent of the operatives and tradesmen will be the first subscribers, and that they will willingly assist the committee by suggesting from time to time such regulatious as are considered desirable, and will also co-operate with them to induce the compliance of all the members with the established rules of the club.

3. That if the committee experience any difficulty whatever in inducing uniform compliance with the established regulations of the club, it will be perfectly competent for them, at any time, to exclude any individual member conducting himself improperly."

James M. Scott.

*Institution of Mechanical Engineers.*—In another part of the present number, we have given a report of a meeting held at Birmingham preparatory to the formation of an Institution of Mechanical Engineers, and we here propose to record onr impressions upon that subject. It appears to us, then, that such an institution is greatly wanted, both because the pressure of business at the Institution of Civil Engineers prevents mechanical engineering from being adequately represented by that corporation, and because young men find themselves overshadowed by the great names they meet there collected, and are deterred from entering upon courses that would event in their own and the general improvement. That an institution, however, shall be representative of the mechanical engineering skill of this country, however it is indispensable that its head quarters should be in London. Any attempt to make a provincial institution a national one must end in failure, and anything short of a national institution will fail to satisfy the want so generally experienced. We hear it is in contemplation to make the meetings monthly, but how far could twelve meetings in the year go to represent the mechanical progress of this great country? Branch institutions there may be, which could hold their meetings less frequently, but in any national institution one night in the week will be little enough to dispatch the important subjects which, if it be of any avail at all, must necessarily be brought before it. Nor would it do to make the institution a peripetetic one. The greater number of the members being engaged in active business pursuits, would find it extremely inconvenient to leave home frequently, and the inevitable result would be that the meetings would be deserted. We hold it therefore to be indispensable to success that the institution should be a London one, and that the meetings should be not less frequent than once a week; and this, we believe, is the opinion to which the more intelligent among the members are inclining. With these intentions, and with good management, the institution cannot fail to succeed : it has a prodnctive field to cultivate, and skill and industry are only required to secure the fruits it is competent to yield.

*Stephenson's Improvements in Locomotive Engines.*—A patent has been taken out by George Stephenson and William Howe for improvements in locomotive engines, which are calculated to cure completely the evil of a rocking motion in locomotives. Instead of the engines being placed side by side, three cylinders are employed, of which one is of the usual area, and the others half of the usual area. The smaller cylinders are placed so that the connecting rods attach themselves to pins in the wheels in the manner of outside cylinder engines, but the two pistons move simultaneously. The larger cylinder is placed in the middle of the carriage, and operates upon a crank in the axle. It is clear that by this arrangement oscillation cannot be produced by the momentum of the piston or its connections, for the forward motions of the pistons of the outside cylinders being simultaneous, the momcntum of one piston balances that of the other, and the momentum of the piston of the central cylinder cannot produce oscillation, as it acts in the middle of the carriage, and presses no more on the one side than on the other. The general arrangement of the locomotive is the same in other respects as that of ordinary locomotives—the only peculiarity being in the use of three cylinders, and their distribution as before described.

*Engineers for the Navy.*—The government, it seems, is beating up for recruits in the engineer departmcnt of the Navy, and the walls of our provincial towns are now placarded with bills, coaxing engineers to enter Her Majesty's Service. We have long foreseen that it would come to this; the Admiralty, we were confident, would be too stiff-necked to adopt the alternative of raising engineers to a rank in the service answerable to their responsibilities, and the result, it was easy to predict, would be that every engineer, of the most slender pretensions to competency, would leave the service so soon as he could find suitable employment elsewhere. We told the Admiralty that their expedient of raising the pay would of itself prove as futile as the result has shewn it to be; and the only effect of the experiment has been to entail additional expense upon the country, without abating any of discontent which is the inevitable concomitant of so vicious a system. How is it that the Peninsular Company, the Halifax Company, or *any* other Company never require to placard the walls to draw engineers into their service? If there be a dearth of engineers, *they* must equally feel it; yet it is well known that the situation of an engineer in any respectable company is greatly coveted; every vacancy has numerous applicants, and a situation is rarely willingly surrendered. In the Navy, on the contrary, they have to hoist placards in the hope of catching some of "the maimed, the halt, and the blind," to whom alone such advertisements are eloquent. In commercial steam vessels there is a continual improvement in the steam department: in the Navy there is a rapid declension. Among engineers the fact of being in the employment of the Admiralty is beginning to be reckoned a reproach; and the secession of the best men from the service, which is now taking place, must add to the severity of the imputation. There is no hope that justice will be done to engineers by Navy men, so far as we can discern; and the best advice we can give the engineers is to "come out from among them." The occupation of a naval engineer is one calculated to operate as a barrier to improvement, inasmuch as, after a cer.ain time, it inculcates nothing but routine; it diminishes a man's self respect by placing him at the mercy of a swarm of petty tyrants, and it subjects him to all the disgusts incidental to the existence of responsibility without power. Why should engineers obtrude themselves into such a Pandemonium? We can discern no reason, so long as employment can immediately be had by every engineer who understands his business; and the only intelligible motive for remaining in the Navy exists on the part of those who *do not* understand it. Let the Navy then keep the refuse that any one else would reject, but, as regards the good men, let there be a regular clear out.

*The Carrier System upon Railways.*—The railways, it appears, notwithstanding the omens of insecurity which mark their present career, persist in defying public opinion by drawing still tighter the bonds of monopoly. The North Western Railway Company has recently decided that it will no longer allow private persons to carry goods upon that line; thus converting a public highway—which every railway was intended to be—into an instrument for securing a monopoly of locomotion between different parts of Her Majesty's dominions. We are not concerned, however, for the result of these new amalgamations and oppressions, for they will the sooner bring about the downfall of the structure which presses so intolerably upon the interests of the nation; and the blow will be the more easily dealt when it can take effect upon a single neck. Powerful as the railways are, they will find themselves impotent when the other interests of the nation are arrayed against them, and to this conflict we must shortly come. Public opinion will support any ministry that will undertake to put the bridle in their mouth, and will indeed compel those who may be in power to adopt some course to rid the country of such an anomaly as the existing system of railway domination. There is a compensating power in nature that will redress such evils as those incidental to our railway system in its own way, and the hour of deliverance is fast approaching.

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## Art. IX.—NOVELTIES IN ART AND SCIENCE.

*The Explosive Gun Cotton.*—The explosive cotton, the discovery of which we announced some months ago, has latterly been attracting much attention, and, as generally happens in the case of important discoveries, there are now many pretenders to the credit of having first found it out. It appears indisputable, however, that Professor Schönbein was the first explorer of this new field, and by him the invention has likewise been brought to its present perfection. The gun cotton exerts greater force than an equal weight of gunpowder, and, when fired off, produces very little smoke. It explodes at a temperature of about 400° of Fahrenheit, with a vividness of flame which is perfectly dazzling, leaving scarcely any residue behind. When some of the cotton is placed upon gunpowder, the cotton may be exploded without firing the gunpowder. Dr. Otto, Professor of Chemistry in Brunswick, gives the following recipe for the preparation of explosive cotton:—"Common, well-cleaned cotton is dipped for about half a minute in highly concentrated nitric acid, (the acid which I use being made by the distillation of ten parts of dried saltpetre and six of oil of vitriol,) and then instantly placed in water, which must be often renewed, in order to free the cotton from the acid with which it is impregnated. Care must then be taken that all the knotty particles of the cotton are properly disentangled, and that it is thoroughly dried. After this the explosive preparation is ready for use."

*Cause and Cure of the Potato Disease.*—Sir James Murray has sent us a letter on the subject of the potato disease, in which he attributes the origin of the disease to disturbances in the electric equilibrum of the earth, and he proposes as a remedy, the erection of conductors at intervals along the fields, which he has found to be productive of beneficial effects in practice. We here introduce an extract from Sir James' letter which is well worthy of attention:—"Having in 1832 pointed out the then unequal condition of the electric fluid over a large belt of our globe, and having shewn the untoward effects of disturbed galvanic action upon the solids and fluids of delicate human beings, and well knowing (as every person has observed) the severe injuries resulting from passages of galvanism through plants, I was led to pass and withdraw electricity from living vegetables artificially, to compare the results. Of all other plants, the potato suffers most in the mechanical or polar relations of its molecules, by the transmission or abstraction of electricity, and it is also speedily altered in the chemical condition of its solids and fluids. When a cloud or an excess of negative or positive electricity excites a current of its opposite element through the soft and watery stem or tuber, the texture itself, as well as the chemical atoms of the plant, is altered, and the shock is proportioned to the degree of electric disturbance excited. From many data, too numerous to mention, it seems that during late years some terrestrial and atmospheric changes have caused a very untoward disproportion between the natural quantity of electricity issuing in currents and counter currents from the air to the earth, and the contrary. The potato stem, made up of cells and water, with pointed leaves, and succulent tubers, is most amenable to the conduction and to shocks of electricity. Corn defends its stalks by a varnish of non-conducting glass, or siliceous enamel; other domestic vegetables are by no means such ready electrical conductors as the stems of the potatoe. Having often tried the effects of artificial disturbance of electric (fluid) on the potatoe, I covered some stems with bottles, such as are used to carry vitriol; and I can safely affirm that all the stalks so *insulated,* escaped, whilst others were struck, along direct lines of the same field. But as this remedy (if found to be a remedy) is not applicable on a large scale, I tried the plan which I had carried into effect in the rice grounds of Italy, viz., the use of horizontal electric rods. These were small copper wires, fastened at one end of a ridge to an iron rod inserted deep into the moist ground. Similar stakes were inserted at certain spaces, till at last the copper wire attached to these iron stakes, reached the other end of the ridge. These iron rods or stakes stood about two feet above the surface of the ridge, or eight or ten inches higher than the potatoe stalks. These trials were limited, but extremely encouraging in their results. Ridges defended by a wire along their entire length were much more safe than those left without these horizontal lightning rods."

*Iron for the French Navy.*—The French complain very much of the difficulty they find in procuring iron for nautical purposes. The *Journal du Havre* says—The inferiority of our commercial navy is to be attributed solely to the high price of the materials necessary for the construction and equipment of our vessels. If we compare the difference of expense in fitting out our vessels to those of Russia and Austria, we find it higher at least 30 or 35 per cent., and that a vessel of 400 tons, which at Triest would not exceed the cost of 65 to 68,000 francs, could not be launched at Bordeaux under from 90 to 95,000, owing to the high duty in France on canvass and iron. Let us confine our observations to iron, and point out the enormous expense of chain cables in France, and the economy that would result if the protective duty on that article was suppressed. According to minute calculations, the value of the chain cables is equal to one-sixteenth of the cost of a vessel. Abroad, the price of chain of 20 to 35 millimetres varies from 36f. 40c. to 43f. 30c. the 100 kilogrammes. In France, chains of the same dimensions cost from 72f. to 76f., or nearly 98 per cent. more. On chains of lesser dimensions the difference is still greater. Thus chains of 10 millimetres, which in France cost 125f., are only worth 58f. 50c. in England, and the difference is easily explained. On chain cables above 20 millimetres the import duty is 41f. 20c. for the 100 kilogrammes. This duty is almost a prohibitive one, and yet it still serves as a check on our privileged industries, which content themselves with making us pay them double what we should pay them elsewhere; but for chains under 20 millimetres the prohibition is complete, and we are obliged to buy in the only market open. The result of this is that iron cables are dispensed with as much as possible, often when they would be of the greatest service, and all the French traders are obliged, when they do buy them, to pay double what they could procure them for in another market.

*Copper Boats.*—We have been informed of the introduction of a novelty in river and port navigation, which, if it bears out all that is claimed for it, cannot be long before it comes into general use. It is nothing less than a boat of copper, made of four sheets only, stamped to due form by powerful machinery, and rivetted together. It is 23ft. long, 5ft. wide, has four times the strength of wooden boats, and requires one-third only the power to propel at the same speed as a wooden boat of the same dimensions; one-third less weight; no caulking, re-nailing, or painting is required; and, when worn out, the metal will sell for three-fourths of the first cost. Boats, cutters, gigs, ship's-boats, race-boats, and others, from 10ft. to 60ft., may be made in four pieces. Their strength has been tried by dashing them against stone piers; and it appears almost impossible to sink them.

*Porous Draining Pipes.*—The following is a description of a new pipe for the purpose of drainage, made by the admixture of certain ingredients with the clay, so porous as to admit of the water passing through it in a filtered state to the drain. A prize was awarded by the Yorkshire Agricultural Society for this pipe to Mr. Charnock. These porous pipes are intended mainly for draining those lands where quicksand prevails in the substratum, and which from it extreme fineness is very liable to insinuate itself into, and ultimately stop up, the drains that are laid with the ordinary tiles or pipes. The experiment which was exhibited consisted of a porous pipe about two feet long, and two inches internal diameter, laid at the bottom of a tin case, made to represent the section of a drain, and covered to the depth of four or five inches with the finest sand, and then filled up with water, one end of the tube in the case being perfectly sealed, and the other protruding so as to show the water dropping from it in a filtered state. This process had been going on for several days without the least appearance of diminution in the amount of filtration, and it seemed to us likely to continue *ad infinitum* if the supply of water was kept up. The price at which they can be manufactured is not exorbitant; and certainly, judging from the effect produced, their adoption in such situations as those for which they are especially designed, must ensure the most perfect of all drainage—that of continuous filtration through an entirely closed and uninterrupted line of pipe.

*Messages sent by the Electric Telegraph.*—The electric telegraph between Brussels, Malines, and Antwerp, was opened to the public for individual communications on the 9th ult. The charges are fixed at 50 c. from 1 to 20 words, 10 c. for the reply, and 50 c. for communicating it to the residence of the inquirer. The scale of charges for messages sent by the electric telegraph on the South-Eastern railway is 5*s.* for a message of 20 words. The charge to Tonbridge is 5*s.*; to Maidstone, 7*s.* 6*d.*; to Folkestone and Canterbury, 10*s.* 6*d.*; to Dover 11*s.*; and to Ramsgate 12*s.* 6*d.*

*Recipe for Making Aventurine.*—We gave a recipe for making Aventurine Glass in the *Artizan* about three years ago. A late number of the *Builder* has the following:—This costly aud beautiful sort of glass, used for the ornamenting of objects of art and vertu—could not be hitherto made but at Venice. Only so much was known, thatit was very minute crystals of metallic copper of great lustre, which, mixed throughout the mass of dark yellow reddish glass, imparted to this substance that lustrous and iridescent appearance for which it was so much praised. Messrs. Frémy and Calendeau, chemists, have lately laid before the French Institute their procedure of making this valuable substance. It consists in the mixing of pounded glass with hammerschlag and oxide of copper, and keeping both for a considerable time in a state of fusion. By these means, the copper crystallises in the glowing mass of glass in the shape of small octohedra, which, being dispersed through the mass, imparts to it that beautiful scintillating appearance. Still the original Venetian samples and those made by Messrs. Frémy and Calendeau were not of equal quality, the mass of glass wherein the crystals are imbedded being in the former clear and pellucid, in the latter rather soily, and only transparent: the crystals in the Venetian are large, very regular; in the French, small, regular, and fibrous. The principle, however, is found, and it will only require (as with everything else) time and experience to equal the Venetian patterns. This information may be useful to our now unshackled glass manufacturers.

*Engine for Draining the Lake of Haarlem.*—We observe in several of the papers an account of the engine constructed lately for draining the Lake of Haarlem, and which has recently been set to work, in which extravagant commendation is bestowed upon a work in no way deserving of it. The cylinder of the engine is an annular one, whereby the friction and leakage are increased, and the pumps are wrought by levers set radially round the cylinder, whereby a strain is thrown upon the piston if the pumps draw unequally, or some of them be thrown out of action. In the *Illustrated News* a great merit is claimed for this engine on the ground of saving fuel, which, it is there said, is consumed at the rate of 15lbs. per horse power per hour by ordinary pumping engines, whereas in this engine it is not $\frac{1}{6}$th of that amount. But it is quite a mistake to say that in ordinary pumping engines the consumption of fuel is 15lbs. per horse power per hour, the fact being, that in Cornwall, where the Haarlem engine was made, the consumption of the pumping engines is quite as small as that of this boasted leviathan. We consider the use of such an engine injudicious for any purpose, but especially so for a short lift; and a better result would be realized with less expense by the adoption of the centrifugal pump, which a small engine running at a high speed would efficiently drive. Messrs. Joseph Gibbs and Arthur Dean must reserve their boasts for Amsterdam if they wish them to be credited, for in this country we know better than to praise a mammoth whose only claims to attention are traceable to largeness of size and imperfection of contrivance. The Haarlem Meer Commissioners have under consideration a plan for leading the sewage of Amsterdam to irrigate the bed of the lake after it has been drained, with the view of increasing the fertility of the land.

*New Dioptric Lighthouse on the South Foreland.*—A new lighthouse has been erected on the South Foreland, in which a dioptric light of the kind used in the French lighthouses is employed, in which a single large lamp is substituted for the numerous small lamps employed on the English system. The lamp is placed amid a number of prisms by which the rays of light are dispersed and broken up, but the rays are collected again by 8 immense lenses and poured forth in a flood of light which rivals that of the sun. The lens employed is of the plano-convex species, and is built of separate rings or zones, whose common surfaces preserve nearly the same curvature as if they constituted portions of one complete lens. To form a lens of such magnitude of one piece of glass would be hardly possible; and, if it were possible, the necessary thickness of the glass would greatly obstruct the light. The light is found by experiment to be equal to that afforded by nine common reflectors; and it is calculated that, by a consumption of oil equal to that of 17 common argand lamps, with reflectors, an effect is produced equal to that of 30 lamps and reflectors. The metallic reflectors in ordinary light-houses having a very delicate silvered surface, require much care and attention; while, in this lighthouse, there is only one lamp to trim, and the lenses being of glass, require little or no labour to keep them bright. On the other hand, these Dioptric lights have not the wide dispersive range which is so necessary in fixed lights, and there is a greater danger of accident to the light, but the lamp has an automatic contrivance which gives timely warning of the oil running low, or of any derangement occurring to the apparatus. The light is enclosed in a lantern of plate-glass, and the tower is divided into three floors: in the lower one is stored the supply of oil; in the second is a stove, which, being kept burning, preserves the atmosphere of the lighthouse dry, so as to prevent the lantern and glasses being obscured by damp; and the third is devoted to the purpose of ventilation.

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## Art. X.—LETTERS TO THE CLUB.

*Fenton and Murray's Rules for Calculating the Proportions of Engines.*—I send you a collection of rules for calculating the proportions of the various parts of land engines, which I have had for some time in my possession, and which I believe, to be those followed by the eminent firm of Fenton and Murray for a number of years in their extensive practice. Some of these rules are inferior to those given in your Treatise on the Steam Engine, but others of them are more simple and may furnish useful information to those ambitious of perfecting their knowledge of the subject. The preliminary remarks upon horses' power will not be reckoned quite orthodox at the present day, it being well known to engineers that a horse power is now reckoned to be 33,000lbs. raised one foot high in the minute, instead of 50,600lbs. as these rules assume; but then, the effective pressure in Mr. Watt's engines was only rated at about 7lbs. on the square inch, instead of 10lbs. as is here assumed, and the excess of the multiplier is redressed by the corresponding excess of the divisor. I am, &c.

*Birmingham.* GATHERER.

### FENTON AND MURRAY'S RULES FOR STEAM ENGINES.

A horse's power is equivalent to the raising a weight of 230lbs. averaged, to the height of 202 feet in a minute, which makes his momentum equal to 50600lbs. raised 1ft. high in a minute: 23in. in area is equal to a horses' power of a steam cylinder, and each square inch the vacuum acts with a pressure of 12lbs. averaged upon the surface of the piston: but on account of the friction that attends the engine, the working pressure of vacuum is only 10lbs. upon every square inch of the area of the piston doing work, and consequently, the safety-valve on the boiler must be loaded with a weight of 3lbs. upon every square inch of its area. When the number of square inches, or number of horses' power is wanted, to find the diameter of the steam cylinder equal to the number of steam engines or horses' power required—

*Rule:*—Multiply 23 square inches by the number of horses' power required. The product gives the number of square inches in the area of the cylinder: the square root of this extracted will give a side of a square equal in area to the cylinder: this side multiplied by 1·13 will give the diameter in inches; and if you want the side of a square equal in area to the diameter of the cylinder, multiply the diameter by ·889: and if you want to find the number of square inches contained in the square, multiply the side of the square by itself. *Example* to illustrate the foregoing rule. I wish to know the diameter of a steam cylinder that will equal the power of 44 horses; $23 \times 44 = 1012$ and $\sqrt[2]{1012} = 31{\cdot}0811$ number of square inches, therefore, $31{\cdot}811 \times 1{\cdot}13 = 35{\cdot}94643$ diameter inches, steam cylinder, and $35{\cdot}94643 \times {\cdot}889 = 31{\cdot}95839827$ in. in side of the square.

The diameter of the steam eduction-valves must be 1-5th of the diameter of the steam cylinder. Six times the square root of the diameter of the cylinder should be the length of the crank, and twice the length of the crank is the stroke of the engine. When the length of the crank is proportioned to six times the square root of the diameter, then the piston will go through a space of 220ft. with a weight of 230lbs. in the minute for one horse power. But when the length of the crank is less, or not in that proportion, then the piston is retarded, and works through a space of 20ft. less for every once square root of the cylinder that is reduced upon the length of the crank, and becomes a burden of more than 230lbs. for a horse power upon the area of the cylinder, which burden or number of pounds will be known by dividing 50600lbs. the momentum of a horse 1ft. high in a minute, by the number of feet less than 220 after the reduction is made of 20ft. for every square root of the diameter of the cylinder that is reduced upon the length of the crank. After this number of pounds burden is found divide the number of pounds upon the area of the steam cylinder by the number of pounds burden, and you will find the number of horse power the steam cylinder will be equal to. Six times the length of the crank, or 3 1-5 times the stroke of the engine ought to be the length of the walking beam. The breadth of the beam in the middle ought to be the size of the cylinder's diameter, and the mean or middle centre, and the centres belonging to the beams ought to be each in diameter the diameter of the steam valve. The radius and parallel bars must be $\frac{1}{4}$ of the length of the beam. The front and back links ought to be the length of the crank, though commonly made 9-10th of the length of the crank. The mean diameter of the fly-wheel ought to be 9-10th the length of the beam. The length of the connecting rod ought to be $2\frac{1}{2}$ times the length of the stroke, or 5 times the length of the crank. The diameter of the air-pump and condenser must be ·72 the diameter of the cylinder. The diameter of the cold water pump ought to be $\frac{1}{3}$ of the diameter of the air-pump, and is placed into $\frac{1}{4}$ the length of the beam from the centre. The hot water pump ought to be the diameter of the steam valve, and is placed in 1-8th the length of the beam from the main centre.

Four ale gallons is sufficient injection water to an engine of 1 horse power per minute; the discharging valve of the air-pump is 4 times the area of the steam valve: the foot valve belonging to the condenser is 3 times the area of the steam valve. The blow-through valve ought to be $\frac{3}{4}$ the diameter of the steam valve. The steam cylinder-way must be the same area of the steam valve. The throttle valve and steam pipe must have the same area as the steam valve. Concerning the eccentric wheel—the diameter of the eccentric wheel ought to be the same diameter of the steam cylinder* and its centre is thrown back 1·25in. for every foot in length of the stroke of the engine. When the crank is placed perpendicular either at the top or bottom centre, the full throw of the eccentric must be placed forward, the same way the crank revolves, 1·25 for every foot of stroke, which is the time the upper steam valve and lower eduction valve begin to lift; or in other words, when the full throw of the eccentric is placed perpendicular, when, at the top or bottom centre, the crank must be placed backward from the same way the crank revolves to 1·25in. for every foot of stroke, or ·2 of the length of the crank. The proper lift for the steam and eduction valves will be found by dividing the square of the diameter of the steam valve by the circumference of the valve. The crank that is placed upon the end of the wiper or tappet shaft, that the eccentric rod plays for lifting the valves, ought to be in length the throw of the eccentric backwards and forwards. The wiper, or tappet shaft to lift the steam eduction valves, ought to be in length $\frac{3}{4}$ of the throw of the eccentric backwards and forwards.

Concerning the boiler.—27 solid feet is sufficient for a boiler to a patent engine of 1 horse power, 23 solid feet for an atmospheric improved, and 20 for an atmospheric common.

*On Atmospheric Engines, improved and common.*

In an atmospheric improved engine, the pressure of vacuum is equal to 7·5 lbs. upon every square inch in the area of the cylinder. In an atmospheric common, the pressure of vacuum is about 5·5 lbs. upon every square inch in the area of the steam cylinder. A short and correct way of finding the number of horse power of those two last kinds of engines, when it is known what power the cylinder of a patent engine is equal to, when it is allowed to have its proper stroke, is this:—an atmospheric improved engine is equal to ·75 of a patent engine, an atmospheric common, is equal to ·55, allowing the same area of cylinder.

To find the number of strokes that a patent, improved or common engine ought to make in a minute, by knowing the length of the proper stroke in feet.—

*Rule:*—Divide 220 ft. the space the piston will pass through in a minute by doubling the length of the stroke: the quotient is the number of strokes the engine will make per minute.

The diameter and breadth of the ring of the fly-wheel with 7 times the momentum of the piston given, to find the thickness of the fly equal to that momentum for one minute.

Find the velocity of the fly per minute, and the momentum of the piston, being multiplied by 7 and divided by the velocity, will give the number of lbs. weight in the ring of the fly, which, being multiplied by 3·83, will give the number of solid inches in the rim. Find the circumference of the fly in inches, and divide the number of solid inches by it, which will give the area of the section of the ring, which divide by the breadth, and it will give the thickness. *Example:*—The diameter of a steam cylinder is 36 ins., the stroke 7·2 ft., the mean diameter of the fly is 11·88 ft., and the breadth of the ring is ·75 of a ft., required the thickness of the fly in order to be equal to 7 times the momentum of the piston, then $36^2 = 1296 \times ·785 =$ 1017·8784 × 10 lb. = 10178·7840 × 220 = 2239332·4800 momentum of the piston per minute × 7 = 1567327·36 or divide by 220 × 23 lbs = 50600 the momentum of a horse power which will give 44·25 horse power, and 220 ÷ 7·2 × 2 or 14·4 ft. double stroke gives 15·27 strokes per minute then—

| | |
|---|---|
| 15·27 | strokes per minute |
| 2 | |
| 30·54 | revolutions of fly |
| 7·2 | length of stroke |
| 3·2 | $\frac{3}{4}$ |
| 144 | |
| 216 | |
| 23·04 | |
| 8 | |
| 18·432 | |
| 75 | |
| 17·682 | |
| 3·1476 | |
| 251328 | |
| 188496 | |
| 219912 | |
| 31416 | |

55·543488 feet velocity of ring, and 1567532736 ÷ 1696·28322 ft. per min. velocity = 9240·98 lbs. into rim of fly ÷ 666·516 lineal in circumference = 53·37 area of ring, and 53·37 ÷ 9 ins. the fly ring must be to

The diameter of a cylinder is $30^2$, and the length of the stroke 3 ft., required the power?

Diameter $30^2 = 900 \times ·7854 = 706·86 \times 10$ lbs. per in. is 7068·6 men, $\sqrt{30}$ in. = 5·5 × 6 = 33 ins., the crank ought to be 33—18—15; the crank is too short to produce the best possible effect; then 15 ÷ 5·5 = 2·73 number of times reduced, and 18 ft. × 2·73 = 48·6 ft. lost, then 220—48·6 =171·4 feet, then $706·86 \div 23^2 = 30.733$ horse power the engine would be equal to if it had a proper length of stroke, as 220 : 171.4 : : 30·733 : 23 horse power only the engine is equal to, which is owing to the improper length of stroke. Or thus—7068·6 lbs, pressure × 171·4 ft. velocity, is equal to 1211558·04 momentum ÷ 50600 lb. = 23.74 horse power as before, 50600 is the momentum of horse power one foot high in a minute, or 230 lbs. at the rate of 220 ft. per minute.

To find the power of an engine in horses' power, assuming the load on the piston to be 8·68 lbs. per square inch, and that the steam is not expanded,—

*Rule:*—Multiply the square of the diameter of the cylinder in inches by the motion of the piston in feet, and divide the product by 4840, the quotient is the power of the engine in horses' power.

*Example:*—$42^2$ = 2304 × 96 ft. in motion = 221184 ÷ 4840 = 45·6 horses' power.

To find the proper diameter for the cylinder to exert a given power, having given the space in feet through which the piston is intended to move per minute.—

*Rule:*—Multiply the number of horses power by the constant number 6050: divide the product by the motion of the piston in feet per minute, and the square root of the quotient is the proper diameter for the cylinder of the engine in inches.

*Example for a Twenty Horse Engine.*

If the piston is to make $21\frac{1}{2}$ double strokes per minute of 5 ft. long = 215 feet

To find the quantity of water evaporated from the boiler. *Rule:*—Multiply the square of the diameter of the cylinder in inches by the motion of the piston per minute in feet, and divide the product by 21100; the quotient is the quantity of water evaporated per minute in cubic feet. *Example:*—Cylinder 48 in., diameter squared = 2804 circular inches = (8 ft. stroke, 12 per min.) 96 feet motion per min. = 221184 ÷ 288000 = ·768 cubic feet evaporated per minute. To find the boiler surface requisite to be exposed to the fire and flame. *Rule:*—Multiply the square of the diameter of the cylinder in inches by the motion of the piston per minute in feet, and divide the product by 600; the quotient is the fire surface. *Example:*—$48^2$ = 2304 × 96 ft. in motion = 221184 ÷ 600 = 368·64 square feet of fire surface.

To find the quantity of coals that will be consumed. *Rule:*—Multiply the square of the diameter of the cylinder in inches by the motion of the piston per minute in feet, and divide the product by 576; the quotient is the quantity of Newcastle coals consumed per hour in pounds. *Example:* $48^2$ in. = 2304 × 96 ft. in motion = 221184 ÷ 576 = 384 lbs. of coal per hour.

To find the proper diameter for the hot water pump. Having given the diameter of the cylinder in inches, the distance in inches from the centre of the great lever to the main joint by which the piston-rod is suspended, and the radius in inches of the joint by which the rod of the hot water pump is suspended. *Rule:*—Divide the square of the diameter of the cy-

* This is much too large in the case of large engines.

linder in inches by 240; multiply the quotient by the radius in inches of the main joint for the piston-rod, and divide the product hy the radius in inches of the joint for the hot water pump: the square root of the quotient is the proper diameter for the hot water pump in inches.

*Dimensions of the Air-Pump.*

The air-pump is generally $\frac{2}{3}$ of the diameter of the cylinder, that is, 4-9th of the area, but the motion of the air-pump bucket being only half as great as that of the piston, the capacity of the air-pump will he only 4-18th of that of the cylinder; and again, as the cylinder receives steam both in the ascent and descent of the piston, and the air-pump exhausts only when its bucket is drawn up, the effective capacity of the pump will he only 4-36ths or 1-9th of that of the cylinder.

*Area of foot valve passage.*

Should he about $\frac{1}{4}$ of the area of the air-pump and the apertures through the valves in the air-pump bucket are nearly the same proportion. The discharge valve is usually made rather larger than $\frac{1}{4}$ of the area of the pump.

*Dimensions of the Cold Water Pump.*

Having given the diameter of the cylindcr in inches, the distance in inches from the centre of the great lever to the joint by which the piston-rod is suspended, the distance in inches from that centre to the joint by which the bucket of the pump is suspended.

*Rule.*—Divide the square of the diameter of the cylinder in inches hy 24: multiply the quotient by the distance in inches at which the piston is suspended, and divide the product by the distance in inches at which the pump hucket is suspended. The square root of the last product is the proper diameter for the pump in inches.

*Note.*—The cylinder of the douhle engine expends steam continually, when its piston is ascending as well as descending, hut the pump only raises water during the ascent of its bucket, hence the effective capacity of the pump to raise water is 1-48th of the effective capacity of the cylinder to expend steam.

*Example.*—Suppose 20 horses' power, with a cylinder of $24^2 = \frac{576}{24}$in. $= 24 \times 96$ inches radius $= \frac{2304}{40} = 57{\cdot}6$ circular inches for the area of the pump-harrel and $\sqrt[2]{57{\cdot}6} = 7{\cdot}59$ in. for the diameter of the pump.

*Note.*—For small engines under 20 horses' power should he at the rate of 1-36th of the effective capacity of the cylinder instead of 1-48th. The proper diameter at $\frac{1}{2}$ stroke may be found hy dividing the diameter of the cylindcr by 4·9.

The quantity of cold water to he injected into the condenser would be 1-60th part by measure of the quantity of steam actually expended; and as the cold water pump raises a little more than that proportion into the condensing cistern, a small surplus of water will run waste from it. When the injection-cock is set quite open, the area of its aperture should he at the rate of 1-15th of a square inch for each horse power, that is, supposing the capacity of the cold water pump to be 1-48th of that of the cylinder; but if the pump is larger than that proportion, then the cock should be larger, hecause it should in all cases he capable of injecting very nearly as much water as the pump can supply.

Taking $26\frac{1}{2}$ in. of mercury for the usual state of the exhaustion, it is equal to a column of water $(26{\cdot}5 \times 1.129 =)$ 29·92 feet high, and that may be assumed for the pressure which is to urge the cold water through the passage of the injection cock.

Thus the square root of $29{\cdot}92 = 5{\cdot}47 \times 8{\cdot}021 = 43{\cdot}87$ water flows through a small aperture with a velocity of about ·65 of the velocity that a body would acquire by falling the depth, the aperture is heneath the surface of the watcr.

*To find the quantity of injection water.*

Assuming that it has no expansive action, that the cold water is at 50 deg. of temperature, and the hot well at 100 degrees.

*Rule:*—Multiply the square of the diameter in inches hy the motion of the piston in feet per minute, and divide by 10000: the quotient is the qnantity of cold water required per minute in cubic feet.

*Example:*—48 in, diameter squared, $2304 \times 96$ ft. motion per minute $= 221184 \div 10000 = 22$ cubic feet per minute. If working expansively suppose the piston of the above engine is moved 5 feet by the dense steam, and that the expansion number is 1·518; then $22 \div 1{\cdot}518 = 14{\cdot}5$ cubic feet of injection.

*The moving parts of a Steam Engine.*

The size of the piston-rod is always made nearly 1-10th of the diameter of the cylinder, so that the transverse section of the iron rod is 1-100th part of the area of the cylinder. In large engines the piston-rod is rather less than 1-10th of the cylinder, because the length is less in proportion to the diemeter. For single engines the piston-rod is made much smaller, being only 1-12th of the diamcter of the cylinder, and sometimes only 1-14th.

Proper dimensions of the wrought iron links which suspend the piston-rod.—The area of the transverse section, if all the iron in them is about 1-113th part of the area of the piston.

*Rule:*—Divide the square of the diameter of the cylinder in inches by 144: the quotient is the proper sectional area in square inches for the wrought iron in the links.

*Example:*—For a 36 in. cylinder $36^2$in. $= \frac{1296}{144} = 9$ square ins. of wrought iron should be allowed in the main links.

The hreadth of each of these hars is usually 1-12th of the diameter of the cylinder, and the thickness $\frac{1}{4}$ of the hreadth that is 1-48th of the diameter of the cylinder.

To find the proper dimensions for the wrought iron bolts which will he sufficient to sustain the force of the piston.—

*Rule:*—Multiply the square of the diameter of the cylinder in inches hy ·003, and the product will he the sectional area of the bolts in square inches.

*Note:*—Dividing by $333\frac{1}{3}$ would give the same result.

*Example:*—If the cylinder is 48 ins. diameter, $48^2 = 2°304$ins. $\times .003 = 6.912$ square inches of wrought iron will be sufficient to bear the strain of the piston.

To find the proper dimensions for holts or hars of wrought iron to sustain a given force without any danger of hreaking.—

*Rule:*—Divide the given strain in pounds by 4000, the quotient will be the proper section in square inches.

*Example:*—The piston of a cylinder 48 ins. diameter $48^2 = 2°304$ ins., at 12 lbs. per circular inch would exert a force of 27648 lbs. to separate the piston-rod from the main links of the parallel motion.

Then $\frac{27648}{4000} = 6{\cdot}912$ square inches of iron.

To find the proper diameter for screw bolts of wrought iron to enable them to hear a given strain without any danger of breaking.

*Rule:*—Divide the given strain in pounds by 2200 and extract the square root of the quotient.

*Example:*—Suppose that the piston of a 48 in. cylinder exerts a force of 27648 lbs, then $\frac{27648}{2200} = \sqrt[2]{12{\cdot}56} = 3{\cdot}544$ ins. for the diameter outside the threads; if 4 holts each, one would hear 6912 lbs. $\div 2200 = \sqrt{3{\cdot}14} = 1.772$ ins. for the diameter of each screw outside the threads. In practice they are $1\frac{3}{4}$ ins. diameter, 5-6ths of the diameter outside the threads gives the diamcter of the solid cylinder. The depth or thickness of the nut should be equal to the diameter outside the threads: this is proper for nuts which are not required to be frequently turned: the strength of the threads will then be $1\frac{7}{8}$ times the strength of the solid cylinder of the screw △ threads $2\frac{1}{2}$. If the nuts are intended to be frequently turned, their thickness should be $1\frac{1}{3}$ of the outside of the threads, and the nut will contain 8 turns of the thread.

*Dimensions of the Connecting Rod.*

The area of the transverse section of the cross at the middle part of the rod is about 1-28th part of the area of the cylinder, and the breadth across the two opposite arms of the cross is about 1-20th of the whole length of the rod; the lower end of the rod, which acts near to the crank in its smallest part, being 1-35th of the area of the cylinder.

*Note.*—In single engines, the pump-rod if made of cast-iron is, equal to 1-45th of the area of the cylinder.

Dimensions of the main joint pins for the parallel motion and connecting rod.—If the joint-pins be made of wrought iron, they should be equal to 1-10th the diameter of the cylinder; hut if of cast-iron, they will be equal to 1-9th of that of the cylinder, consequently the area of each pin will be 1-81 part of the area of the cylinder; the length of the pin in the bearing part is equal to its diameter.

Dimensions for the joint-pins and rod hy which the air-pump hucket is suspended.—These are proportioned according to the diameter of the air-pump by the same rule as that by which the piston-rod and main joints are proportioned to the diameter of the cylinder,

*The Axis of the Beam.*

The length of the axis between the hearings is between 1-7th and 1-8th of the length of the beam.

The diameter of the cylindrical pivots at each end of the axis is 5-80 of the diameter of the cylinder, and may he found by multiplying the diameter of the cylinder by ·16: or dividing by 6·25 will give the same result. The length of each cylindrical pivot in the bearing part is about $1\frac{1}{4}$ times the diameter.

*Dimensions of the Crank Pin.*

If the crank pin he made of cast-iron, its diameter may may be found by dividing the diameter of the cylinder by $6\frac{1}{3}$. The area of the piston is therefore 40 times the area of the crank pin.

To find the dimensions of the cast-iron beam.—

1st *Rule.*—Divide the square of the diameter of the cylinder in inches by 9, and multiply the quotient by the length of the lever in feet. I the depth is fixed, then to find the breadth.

2nd *Rule.*—Square that depth in inches, and divide the above product by that square; the quotient will be the proper breadth in inches; or if the breadth is fixed, then to find the depth.

3rd *Rule.*—Divide the above product by the breadth in inches, and extract the square root of the quotient; the root will be the proper depth in inches.

*Example.*—Suppose the lever for a cylinder 44 inches diameter is 21·6 feet long, and that it is 34 inches deep in the middle, then $44^2 = 1936$ circular inches ÷ 9 = 215·1 × 21·6 ft. long = 4646 product ÷ (34 in. deep squared) 1156 = 4·02 inches is the proper breadth for the great beam. If the above beam had been 44 inches deep, which is the proper proportion, then the breadth of the beam would have been (4646 ÷ 44 squared) 1936 =) 2·4 in. *Note.*—The breadth given by this rule is greater than the breadth of the middle part, and less than that of the projecting margin at top or bottom.

To find the proper dimensions for the middle part of a cast-iron beam which is required to sustain a given weight in the middle, when supported at each end, being $\frac{1}{3}$ of the depth at the middle.—*Rule.*—Divide the weight in pounds which is to be applied on the middle of the beam by 250, and multiply the quotient by the distance in feet between the supports. If the depth of the beam is given, then to find the breadth; divide the above product by the square of that depth in inches, and the quotient will be the proper breadth in inches; or if the breadth of the beam is given, then to find the depth, divide the same product by that breadth in inches; and extract the square root of the quotient; that root will be the required depth in inches.

*Example:*—The strain occasioned by a cylinder of 36 ins. diameter = 1296 circular inches area, at 28 lbs. per circular inch is 36288 ÷ 250 = 145·15 × 21·6 ft. long = 3135. Then, if the beam be 36 ins. deep at the middle 3135 ÷ ($36^2$ =) 1296 = 2·42 ins. is the proper breadth of the beam; or, if the breadth is to be 3 ins., the 3135 ÷ 3 = $\sqrt{1045}$ = 32·33 ins. for the depth of the beam at the middle.

To find the proper diameter for the neck of the cast-iron axis of the fly-wheel. *Rule:*—Multiply the square of the diameter of the cylinder in inches by the length of the stroke in feet, then multiply the quotient by the constant decimal ·15, and extract the cube root of the last product; that root will be the proper diameter for the neck in inches. Suppose the cylinder to be 24 ins. diameter, and the stroke $2\frac{1}{2}$ ft., then $24^2 = 576$ ins. × 2·5 ft. = 1440 × ·15 = $\sqrt[3]{216}$ : = 6 ins. The utmost force exerted by the piston at the most favourable period of its action being assumed to be at the rate of 11 lb. per circular inch of the piston, then a crank neck proportioned by the following rule, with 8 for a divisor, would be twisted with a strain, which may be found by multiplying the cube of its diameter in inches by 88 pounds, the product will represent the force of torsion in pounds acting with a leverage of half a foot from the centre—hence a cast-iron neck 1 in. diameter and 1 1-9th in. length may be safely subjected to a twisting action of 88 lbs. acting at half a foot from the centre.

*Rule 2nd.*—To find the proper diameter for the cast-iron neck of the axis of the crank when the fly-wheel is not upon that axis. Multiply the square of the diameter of the cylinder in inches by the length of the stroke in feet, divide the product by 8, and extract the cube root of the quotient; that root is the proper diameter for the crank neck in inches, and that diameter multiplied by 1·2 will give the proper length of bearing for the neck in inches.

*Example:*—Cylinder 36 ins. diameter squared = 1296 circular ins. × 7 ft. stroke = 9072 ÷ 8 = 1134, the cube root of which is 10·43 ins. for the diameter of the neck, and (10.43 × 1.2 =) 12·5 ins. is the proper length of bearing. When the fly-wheel is fixed on the axis of the crank, *Rule* I. may be substituted, the length of the stroke for the diameter of the sun-wheel.

*Example:*—Cylinder 36 ins. = $\overset{0\ \text{in.}}{1296}$ × 7 feet stroke = 9072 × ·15 = 1361 the cube of which is 11·08 ins. is the proper length of bearing, and should have been placed here. *Example:*—A cast-iron neck 10·43 ins. diameter cubed = 1134 × 88 lbs. gives 99792 lbs., acting at 6 ins. radius from the centre for the force of torsion which the neck should endure according to this rule. *Proof:*—36 ins. diameter of cylinder squared is 1296 circular ins. × 11 lbs, = 14256 lbs. utmost force of the piston. As this acts at $3\frac{1}{2}$ ft. radius. it is equal to (14256 × 7 =) 99792 lbs. force of torsion acting at 6 ins. radius.

*Note.*—That if the cube of the diameter of the neck in inches is multiplied by 880, the product will be nearly the force of torsion in pounds, which, acting at half a foot radius, will actually twist them off, hence the proportion of the above rule will only be twisted with 1-10th of the force which would break them off.

To find the dimensions for the cast-iron neck of an axis which is to transmit any given number of horses' power when it makes a given number of revolutions a minute.—

*Rule:*—Multiply the number of horse power that the neck is to transmit by the constant number 300; divide the product by the number of revolutions the shaft is to make per minute, and extract the cube root of the quotient: that root is the proper diameter for the cast iron neck in inches: supposing its length of bearing to be 1-5 of its diameter. *Example:*—The whole force of an engine which exerts 60 horse power is transmitted by the neck of an axis which makes 50 revolutions per minute. Then 60 horse power × 300 = 1800 ÷ 50 revolutions = $\sqrt[3]{360}$ = 7·11 in. for the diameter of the neck, and (7·11 × 1·2 =) 8·53 in. is the proper length of bearing.

To find the diameter for the wrought iron neck for the crank axis.—The *Rule* 2nd. will serve by using 9·6 or 10 for a divisor instead of 8, thus—

*Example:*—an engine with a cylinder 32 in. diameter $32^2$ = $\overset{0}{1024}$ in. × 3 ft. stroke = 3072 ÷ 9·6 = $\sqrt[3]{320}$ = 6·84 and (6·84 × 1·2 =) 8.2 in. in length of bearing.

To find the proportion between the power which must be communicated to the rim of a fly wheel, to produce its motion from rest, and the power which is exerted by the piston of the engine in each half stroke.—

*Rule 1st.*—Multiply the square of the diameter of the cylinder in inches by the length of the stroke of the piston in feet: the product may be assumed to represent the power exerted during each half stroke of the piston and must be reserved for a divisor.

*To find the weight of Fly Wheel.*

*Rule:*—The momentum of the piston multiplied by 8, and divided by the velocity (in feet) of the fly at the circumference, will give the number of pounds weight that the ring should be.

*Example:*—What will be the weight of the ring of a fly 12 ft. diameter for an engine having a 20 in. cylinder, 18 in. crank going at the rate of 37 turns per minute?

314·16 = area of cylinder
10 = lbs. pressure on □ inch
______
314.160
222 = velocity of piston in ft. per minute
______
628320
628320
628320
______
697435·20 momentum of piston
8
______
1394·87 ) 5579481·60 ( 4000 lbs. weight of ring
557948
______
160

1394·87 = velocity of the ring of the fly in feet at the circumference per minute.

4000 lb. ÷ 3·83 = 15320 solid inches in the ring, and that divided by the circumference of the ring in inches will give the area of the section thereof.

To find the altitude of a column of water that will feed the boiler of any engine.—

Multiply the number of pounds weight on one square inch of the safety valve by 2.304, or 2·3 for practice, thus, 3 lbs. per inch on a safety valve requires 6·9 ft. altitude above the water in the boiler: 50 lbs. requires 115 ft. which accounts for the necessity of a forcing pump for high pressure engines.

*To calculate the power of a Steam Engine.*

Take 4 lbs. to be the true pressure upon every square inch of the piston, suppose then I say 1-5th for friction, 1-3rd of loss by making use of the crank to change the motion from a reciprocating to a circular one.*

The case then stands thus:—

14 lbs. — 1-5th or 2-8th — 1-3rd or 4·6 = 6·6 lbs, working pressure.

Take the diameter of 24 inches.

$24^2$ × ·7854 = 452·39 × 6·6 = 2985· 77 × 220 ≥ 656870·28 lbs. 1 foot high in 1 minute, $\frac{656870\cdot28}{33000}$ = 19·9 horses

Fractional numbers for the pistons of the following sizes multiplied by the area.

| Diameter of cylinder in inches. | Fractional numbers for the piston. | Horses' power for 8 hours. |
|---|---|---|
| 12 | ·70 | 4 |
| 16 | ·75 | 8 |
| 18 | ·76 | 10 |
| 20 | ·78 | 13 |
| 24 | ·80 | 20 |
| 30 | ·83 | 40 |
| 36 | ·86 | 60 |
| 40 | ·87 | 80 |

* This is a fallacious assumption.

Second. Multiply the mean diameter of the rim in feet by its section in square inches, and the product will represent the mass of cast-iron in the rim. Multiply the mean diameter of the rim by the number of turns it makes per minute, the product will represent the velocity with which the rim moves, then divide that product by the constant number 114·16 and square the quotient, this square will represent the height due to the velocity with which the rim moves, and being multiplied by the second product, (representing the mass of cast-iron,) the resulting product will represent the power communicated to the rim which is to be used for a dividend.

Lastly. Divide the power by the divisor reserved at first, (representing the power of the piston,) the quotient will be the number of times the power exerted by the piston in each half stroke is contained in the power which constitutes the energy of the fly wheel.

*Example:*—Cylinder $17\frac{1}{2}$ ins. diameter squared = 306·25 ins. × 4 ft. = 1225 for the power exerted by the piston in each half stroke. (*Note.*—If this is multiplied by 5.454 lbs. it gives 6681 pounds acting through one foot.) The mean diameter of the fly-wheel 11·5 ft. × 15 square ins. area of the cross section of the rim = 172·5 for the mass of cast-iron in the rim. (*Note.*—If this were multiplied by 9·817 lbs. it would give 169·3 lbs. for the weight of the rim.) The mean diameter 11·5ft. × 48·5 revolutions per min. = 557.75 for the velocity ÷ 114.16 constant divisor = $4.885^2$ = 23·86 for the height due to that velocity, and × 172·5, the mass of cast-iron = 4116 to represent the energy of the rim. Lastly, 4116 energy ÷ 1225 power of the piston gives 3.358 times that the energy of the fly-wheel exceeds the power of the piston in each half stroke.

To find the quantity of cast-iron which should be contained in the rim of the fly-wheel.—*Rule.*—Multiply the mean diameter of the rim in feet by the number of revolutions it is to make per minute, and square the product for a divisor. Divide the number of horse power exerted by the engine by the number of strokes the piston makes per minute, multiply the quotient by the constant number 2760000, and divide the product by the divisor found as above.

*Example:*—An engine of 30 horse power making 19 strokes per minute, the fly-wheel is $17\frac{1}{3}$ ft. diameter to the middle of its rim, and is turned by a multiplying wheel of 77 teeth and a pinion of 38 teeth, so as to make $38\frac{1}{2}$ revolutions per min. Then 17·33 ft. diameter × 38·5 revolutions = $667{\cdot}3^2$ 445289 for a divisor, and 30 horse power ÷ 19 strokes = 1·58 × by the constant number 276000 = 4360000, which product, divided by 445289 gives 9.79 cubic feet of cast-iron for the rim.

Another example for a small engine which makes a rapid succession of strokes. A 10 horse engine making 25 strokes per minute.—The fly-wheel is $11\frac{1}{3}$ ft. diameter to the middle of its rim, and, being fixed on the axis of the crank, then 11.33 ft. diameter × 25 revolutions = $213{\cdot}25^2$ = 80230 for the divisor, and 10 horse power ÷ 25 strokes = 4 × 276000 = 1104000 and ÷ 80230 = 13·75 cubic feet of cast-iron for the rim of the fly wheel. If this fly wheel had been turned by sun and planet wheels, its rim would have only required $\frac{1}{4}$ of the above.

To find the quantity of matter in the rim of the fly-wheel in cubic feet.—Multiply the mean diameter of the rim in feet by the area of its transverse section in square inches, and divide the product by 45·837, the quotient is the solid contents of the rim in cubic feet. *Example:*—The fly-wheel 12 ft. diameter outside, and the rim 6 ins. deep by $2\frac{1}{2}$ inches thick. The mean diameter (12 ft. — ·5 ft. = ) 11.5 ft. and the area of the transverse section is (6 ins. × $2\frac{1}{2}$ ins. = ) 15 square ins., then 11·5 ft. mean diameter × 15 square ins. = 172·5 ÷ 45·84 = 3·763 cubic feet $\frac{144}{3{\cdot}1416}$ = 45·84 divisor.

To find the weight of cast-iron in the rim of a fly-wheel in tons. *Rule:*—Multiply the mean diameter of the rim in feet by the area of its transverse section in square inches, and divide the product by 228·16, the quotient is the weight of the rim in tons.

*Example:*—Mean diameter of the rim 11·5 ft. × 15 square ins. area = 172·5 ÷ 228·16 = ·756 of a ton.

To find the weight of cast-iron in the rim of a fly-wheel in pounds. *Rule:*—Multiply the mean diameter of the rim in feet by the area of its transverse section in square inches, and multiply the product by 9.817 lbs., the product is the weight in pounds. *Example:*—Mean diameter of the rim in feet $11\frac{1}{2}$ × 15 square ins. area = 172·5 × 9·817 = 1693·4 pounds weight of iron in the rim.

The divisor for the modern practice. The energy is usually 3 times the power exerted in each half stroke, therefore (3 × 858000 = 2·574000 is the multiplier which must be used in that rule, or, in even numbers, 2600000. *Example:*—When the fly wheel of a 30 horse engine is fixed upon the axis of the crank, it must make 19 revolutions per minute, its diameter to the centre of the rim is 20 ft., then 20 ft. × 19 revolutions = $380^2$ = 144400 for a divisor, and 30 horse power ÷ 19 strokes = 1·579 × 2600000 = 4105400 which, divided by 144400, = 28·42 cubic feet.

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*Details of Oscillating Engines.*—I send you some dimensions of the oscillating engines of Messrs. Penn which, in the present state of public opinion respecting oscillating engines which you have been mainly instrumental in producing, will, I have no doubt, be prized by many. The following are some of the dimensions of the new steam vessel *Ariel*, the engines of which were constructed by Messrs. Penn for the Peninsular and Oriental Steam Company:—Diameter of cylinder 68 inches; length of stroke 4 ft. 6 in.; thickness of cylinder $1\frac{1}{4}$ inches; diameter of piston-rod $7\frac{3}{8}$ in.; total depth of piston-rod stuffing-box 2 ft. 6 in.; depth of packing in stuffing-box 5 in.; depth of brass bush in stuffing-box 2 ft.; diameter of steam pipe 12 in.; length of bearing of trunnion $6\frac{3}{8}$ in.; diameter of eduction trunnion 1 ft. 6 in.; thickness of metal of trunnion 1 in.; diameter of steam trunnion 1 ft. 5 in. There is a feather above, and another below each trunnion, of which the depth is equal to the projection of the cylinder jacket, and the length of each is 14 in. The boilers are tubular. Length of tube 7 ft., and diameter $2\frac{3}{4}$ in. I am, &c. P. P.

GREENOCK.—*Artizan Club.*—You have, no doubt, heard of the formation of an *Artizan Club* here, in formation as regards name at least, of your own club in London. Mr. James Scott is the mover in it, and the project seems to be going on very satisfactorily. Mr. Scott will advance the money to build the Hall, which will be repaid to him out of the receipts of the institution. Greenock is much indebted to him for many things, one of which is the "Penny Club," which has wrought much good. The *Artizan Club* is to include working men of every denomination; but chiefly carpenters and engineers, and it is receiving among them a general and grateful support.

*Steam Vessel Tiber.*—This is a vessel lately constructed by Messrs. Caird and Co., for the Peninsular and Oriental Steam Company; she is of iron, and is furnished with direct action engines of the double cross head kind—the air-pumps being wrought by levers in a similar way to that adopted in the Gorgon engines. On the first trial of the vessel, one of the pistons broke, and on a subsequent trial another of them broke—shewing, as I conceive, that the first fracture could not have been accidental. The pistons are dished very much, or have a recess in the upper part, to allow the stuffing-box to dip into them with the view of saving room, and the piston-rods are coned the reverse way as in locomotive engines, and fastened in by a cotter passing through a projection answering to the recess upon the top. This method of construction is attended with many inconveniences, and I understand is to be altered. The engines have been carefully made, and there is much good work upon them, but they have faults too, which I could enumerate if disposed to be critical. The vessel is very well finished, and will, I have no doubt, prove a fast one.

*New Steamers.*—A new iron screw vessel in Messrs. Scott's yard, intended for the Government, and a new iron paddle-wheel steamer in Messrs. Caird's yard, are now drawing towards completion, and will, I believe, do credit to the place of their nativity. They are extremely well finished, and are faithfully built in every respect. Messrs. Scott and Sinclair have two pairs of engines nearly ready for the East India Company, which are a very substantial and excellent piece of work, though perhaps, in some respects, needlessly heavy. Mr. Steele has a large timber steamer now in frame. C.

GLASGOW.—I was lately through the works of Mr. Robert Napier, and never before saw so much doing. He has, they tell me, at present upwards of 5000 horses' power to make, besides a number of iron steamers. There are two pairs of very large engines for driving the screw intended for the government; the screw is to be driven by gearing, but the stroke is short, and the engine will make a great number of strokes in the minute. The slides for guarding the top of the piston-rods are of brass, and are cast hollow, so that a stream of water may circulate within them. Mr. Napier is now making many of his pistons of gun metal, and Messrs. Tod and Macgregor are making some of theirs of malleable iron. The pistons of the steam-vessel *Sultan*, now nearly completed, constructed by Messrs. Tod and Macgregor, for the Peninsular and Oriental Steam Company, are of malleable iron, but a brass facing is interposed between the piston and the cast-iron packing-ring to prevent any tendency the malleable iron might have to waste away in that situation. The engines of the *Sultan* are of the double cross-head kind, with a beam between for the air-pumps. There is more malleable iron about these engines than about any engines I have seen. S.

LIVERPOOL.—The "twenty thousand pounds subscription" scheme, for the erection of free parish churches here, has been already so far successful, that ten thousand have been now subscribed.—In Manchester also a good deal in church building is going on.—Amongst the new erections and improvements in Salford are the Scotch church, at present in progress at the corner of St. Stephen-street and Chapel-street, a perpendicular gothic building, by Mr. Hollins, from designs by Messrs. Travis and Mangell, and the Roman Catholic church of St. John, higher up Chapel-street (a building in the decorated gothic style,) also in course of erection by Mr. Hollins, from designs by Messrs. Weightman and Hadfield, Sheffield architects. A tower and spire rises from the centre of the latter; and these, with the pinnacles to the front, or western entrance, are its chief external characteristics. The tower is 102 feet in height, and the spire 118 feet above the tower. The length of the building is 172 feet; width, 58 feet. The interior comprises a nave, 72 feet in length, with a lofty ceiling, supported by eight massive decorated columns, and intersected by a transept, 120 feet in length, at its approach to the choir, which is 70 feet long. The east window is to be filled with stained glass, in seven lights, 40 feet high. The only fault I have to find with these doings is, that there is too much Puseyism about them, but that fault will cure itself. G.

## Art. XI.—THINGS OF THE DAY.

### FINE ARTS.

*Report of Fine Art Commissioners.*—The Fine Art Commissioners have made a Report to her Majesty upon the subject of the fresco paintings recommended by them for the decoration of six arched compartments in the House of Lords. The first fresco painting was entrusted to William Dyce, A.R.A. The subject was "The Baptism of Ethelbert," and the Commissioners say:—"We have now humbly to Report to your Majesty that the said fresco painting was completed in the month of July last, in the centre compartment of the south wall of the House of Lords, and that we have inspected the same. The design having been before approved by us, of attention was chiefly directed to the work as an example of fresco painting, a method in a great measure new in this country, and in which we deemed it probable that some defects, arising from want of experience, might be apparent; defects which time and practice might in future efforts have removed. We have, however, the satisfaction to state that the work in question presents no evidence of such imperfections; that, on the contrary, it evinces great knowledge of the process of fresco painting, and great skill in its application; that, further, as regards the effect of fresco painting in the locality, we consider that it promises to agree well with the architectural and other decorations therein adopted or to be adopted. We, therefore, beg leave to confirm our former recommendation, and to propose that the remaining five compartments should be decorated with fresco paintings, when the several designs for the same shall have been approved. And being also of opinion that the satisfactory effect of Mr. Dyce's fresco is to be referred, in a great degree, to the style of design and colouring which he has adopted, and considering it desirable that a certain conformity of style and execution should pervade paintings employed in the decoration of architecture, and which must be seen together, we deem it important, without wishing to impose undue restrictions on the invention or taste of the other artists commissioned or to be commissioned to execute the remaining frescos in the House of Lords, that such artists should be recommended to adapt the size of their principal figures, their style of colouring, and the degree of completeness in the execution of their works, so as to make them agree sufficiently with each other, and with the specimen already executed. We have further humbly to report to your Majesty that, having, from time to time, been furnished with drawings by the architect, showing the possible extent to which compartments in the various localities of the Palace at Westminster might be decorated with works of art, we are of opinion that it would not be expedient, with reference to the encouragement of British art, or with reference to the claims which may hereafter be urged for the commemoration of great events, to complete the series of paintings on the walls of the said Palace at the present period; that, nevertheless, in accordance with the principles which have already guided us in deciding on the plan of decoration in the House of Lords, viz., with reference to fresco paintings, stained windows, and statues, proposed for that locality; and also in the selection of statues proposed for St. Stephen's Porch, St. Stephen's Hall, and the Royal approaches; we conceive it to be the duty of this Commission, for the better guidance of present and future artists, and in order to maintain a character of harmony and unity worthy of such a building, to determine a complete scheme for the future decoration of the Palace. We are of opinion that, in determining such scheme, the especial destination of each portion of the building should be attended to; that, in the selection of subjects, the chief object to be regarded should be the expression of some specific idea; and the second, its illustration, by means of some well known historic or poetic incident adapted for representation in painting."

*Shop Fronts.*—The architecture of shop fronts furnishes a field for the architect more thoroughly tentative of his abilities than any other of his ordinary occupations. Here the usual recipes of beauty will not do, and new modes of decoration have to be devised to answer new emergencies. A very creditable performance in this way is to be found in a new shop in Regent Street, No. 160, lately opened, where the decoration is in the rich style of Louis XIV., executed by M. Cambon, of Paris, from the designs of an eminent French architect. The internal fittings of the shop are in the same style as the front, and the general effect is most satisfactory, and reflects credit upon all concerned. The building department of the work was executed by Messrs. Winsland and Holland, of Duke Street, Bloomsbury.

*New Church, Birmingham.*—The new church of Saint Andrew, Bordesley, Birmingham, has been consecrated by the Bishop of Worcester, and is the fifth of ten proposed new churches. It is in the early decorated style, with nave, chancel, north aisle, and tower. The chancel is divided from the nave by an arch rising from octagon pilasters. There is a great east window of five lights. A row of arches, springing from pillars, divides the nave from the aisle, in which latter there is a window, the gift of the architect, Mr. Carpenter, of London. The expense of erection, including the porch and wall, has been about 4,000*l*,

*Monument to Columbus.*—The ceremony of laying the first stone of the monument to be erected to the memory of Christopher Columbus took place at Genoa on the 27th September.

### SUMMARY.

The Hall in the house of the Society of Arts, that was decorated by Barry, is to be cleansed and renovated under the direction of Mr. Hay of Edinburgh.—Carlisle Cathedral is at present undergoing some considerable improvement and repair.—A prospectus of a new translation of "Josephus," to be illustrated by drawings of architectural remains, specimens of Jewish architecture, &c. by Mr. W. Tipping, has been issued by Messrs. Houlston and Stoneman.—The French papers mention the discovery in the Commune of Taillefontaine, in the department of the Aisne, of a vast sepulchre containing the remains of nearly one hundred corpses, and surrounded by a variety of antique articles—including stone hatchets—which assign the sepultures to the Gaulish period.—Earl Auckland, as first Lord of the Admiralty, has laid the first stone of a new church at Pembroke Dockyard.—We learn from Athens, that two very fine ancient statues, one believed to be of Apollo and the other of Ceres, have been found in a house near Vostizza, in Achaia. The Government has takeu measures for their preservation, and it is expected that they will be placed in the museum of Athens. There has also been found in Sparta a sphynx of admirable workmanship, which was immediately sent to the museum.—It is in contemplation, we hear, that Government Schools of Design shall be established in Dublin and Belfast.—The old Priory Church at Christchurch is about to have its northern porch, ceiling, and stone rood-screen restored, according to plans by Ferrey.—The proposed cemetery at Wolverhampton has been sanctioned by the Bishop of Lichfield, and effectual means are forthcoming for its realization.—Lord Morpeth has made, perhaps, as good a move as possible, to obtain the judgment of the "competent persons" on Mr. Wyatt's triumphant statue. His lordship has, we are informed, addressed a circular to all the Royal Academicians requesting that he may be favoured with their opinion as to the effect of the statue on the arch.—The Scottish Association for the promotion of the Fine Arts has issued a notice offering a premium of 100*l*. for the best series of six designs illustrative of the national history.—A week or two ago, we informed our readers that the fine painting of the *Last Supper*, discovered last year in a convent in Florence, and recognised as a work of Raphael's had been proved by a document which has recently turned up in the Strozzi Library, to be the work of Neri di Bicci, a painter who died 22 years before the great master was born.—In France, the King has conferred the decoration of the Legion of Honour on M. Jazet, the eminent engraver. Amongst ourselves, the engravers are not yet recognised as admissible into the chivalric orders.—The church of Belleville has been adopted into the number of French historical monuments, and is about to undergo it is said, a complete restoration.—At Vienna, an exhibition has been opened by the Manufacturing Association of Austria for the display of designs for stuffs; and medals of gold, silver, and platina, are offered as premiums.—The prospects of the Archæological Society of Athens are, according to the *Moniteur Gree*, not flourishing. The subscriptions which had supplied its operations for a time are gradually diminishing; and the committee have therefore come to the determination of attempting to establish a permanent capital, to be deposited at the national bank—and the interest of which only shall be in future applied to its annual works.—Another has been added to the number of republican societies existing in the metropolis for the preservation in print of early literature, in its several departments. The new association is to be called the Cavendish Society, and its object is to produce the works of the most celebrated chemical writers of old.—We are happy to announce that the rumoured destruction of Lord Rosse's telescope has now received a formal contradiction.—The installation of the new Royal College at Alençon took place on the 19th ult. in presence of the Minister of Public Instruction.—From Frankfort we learn that the Germanic Diet has awarded a sum of 130,000 florins to Prof. Schönbein and Dr. Böttiger, on the condition of its being proved to the satisfaction of the military commission of Mayence and the authorities of the fortress, that their invention is of a nature advantageously to supersede the use of the ordinary gunpowder.—From Berlin, it is stated that the King of Prussia has devoted the large sum of £120,000 to the formation of a covered garden in the centre of the city, to be used as a winter promenade by its inhabitants.—The Sardinian Government has, it is stated, entered into a negotiation with Spain for the restitution of the ashes of Christopher Columbus. These are now in the cathedral church of the Havanna; having already undergone two removals—from Seville and St. Domingo.—A weekly journal, to be called the *Contemporaneo*, to be devoted to the investigation of questions of trade, industry, and political economy, is announced for publication at Rome, under the immediate sanction of his Holiness the Pope.—The King of Bavaria, on the 12th inst., laid the first stone of the Pinacotheca—a gallery into which no picture is intended to be admitted that dates before the present century. His Majesty made on the occasion one of those speeches by which certain of the German sovereigns seem to expect that they can smooth at pleasure the popular mind ruffled by their less enlightened measures—buying men's acquiescence in their arbitrary doings by an occasional display of sentiment.—A bust of M. Leverrier, the astronomer, will be given o the College of Saint Lô.

CONSTRUCTION.

*Iron Trade.*—At the quarterly meetings at Birmingham and Wolverhampton, the greatest activity prevailed in every department of the trade, and at Dudley also. No nominal advance upon manufactured iron has taken place—but something hetter—a real and substantial advance. The order hooks, which in the early part of last quarter were filled at prices very considerably below the list agreed upon, are now presenting a different appearance; and the brisk demand for pig iron by most of the first-rate houses who are accustomed to buy, as well as their carefulness to accept orders only to limited amounts, indicate that an upward movement is looked upon as extremely prohable and near at hand. The pig makers have certainly succeeded in obtaining better prices; and for good cold-blast mine pigs 5*l.* 10*s.* was generally demanded.—*Glasgow*, Oct. 10.—The price of Scotch pig iron, delivered free on hoard here, may he quoted to-day at 70*s.* for all No. 1, and 68*s.* for all No 3, per ton nett cash. At the opening of the week sales to a considerable extent were made at fully 2*s.* 6*d.* per ton higher, hut towards the close prices gradually declined, and the prevailing tone of the market is flat. Common bars, 9*l.* 10*s.*; railway bars, 10*l.*; and railway chairs, 5*l.* 17*s.* 6*d.* per ton, free on board in the Clyde. Yesterday and to-day there were no sales reported, and prices are ahout 68*s.* for No. 3, 70*s.* 6*d.* to 71*s.* 6*d.* for mixed numbers, and 72*s.* 6*d.* to 73*s.* 6*d.* and for all No. 1: cash, f.o.b.

*Railway Tunnelling.*—It appears that there are at this moment 104,814 lineal yards, or 59½ miles, of railway tunnelling still to be huilt, and that during the last session of Parliament the construction of 4,705 miles of railway was in all authorised to be carried out, at an average expense of about 19,299*l.* a mile, or 90,802,550*l.* in all. These railways will cross, on the same level, upwards of 209 turnpike-roads, and 1,240 common roads, and the quantity of land requisite for occupation is estimated at 53,356 acres, or nearly 11⅓ acres per mile of railway to he executed.

*The London and South Western Railway.*—This Company have now got possession of nearly all the property necessary for the extension of their line to Hungerford-bridge, and the most active preparations are making for commencing the construction of the works without delay. There will be a magnificent station at Hungerford-bridge. The extent of the erection may be inferred from the fact that its cost will exceed £100,000. The expenses of constructing the extension line from Nine Elms to Hungerford-bridge, including the purchase of property, will not, it is supposed, be under £600,000, making, with the station, £700,000, or the enormous sum of £350,000 per mile. The South Western Company, though making their principal station at Hungerford-hridge, do not mean to stop there, but are to extend their line to London-hridge, where means will be adopted to connect their station with that of the London and Brighton, the South Eastern, and the various other companies which have their termini on the east side of London-bridge. It is calculated that the expense of extending the South Western Railway from Hungerford-bridge to London-bridge will be ahout £400,000, making the sum altogether expended by that company, in carrying its line from Nine Elms into the centre of London, upwards of £1,000,000. The extension to Hungerford-hridge is expected to be finished in eighteen months, and that to London-bridge in three years.

*Victoria Park.*—The operations for planting have been actively recommenced, and it is anticipated that the whole will be completed before the termination of the coming spring. In its present state the park retains all its attractions with the East-enders, and the average of visitors has for many Sundays past exceeded 10,000. The gates at the entrance in Bonner's Fields having been placed up, all persons are excluded at night, except those passing through on business or residents, a night park-keeper being stationed for the purpose. Building is going on very actively and extensively in the neighbourhood.

*Subsidence of a Tunnel.*—A portion of the tunnel lately made on that part of the Newcastle and North Shields railway which is to form the extension to Tynemouth, has given way. The part which has falleu in is a little to the east of Northumberland-square, North Shields, and is about 50 yards in length. Doubts are entertained as to the stability of the rest of the structure. The extension was to be opened for traffic in about a month.

*Coast Defences.*—The coast defences have been of late engaging the attentson of government, and orders have heen given for the preparation of 33 towers hetween Hastings and Seaford. The tops of these towers were cemented over in dome-form up to the top of the spindle on which the swivel gun was fixed. The whole of that covering is to be forthwith taken off, and a new traversing course of stone to he laid down.

*Injury to the South Devon Railway.*—The *Western Lnminary* says that the coincidence of a south-eastern gale with a spring tide has had, in some degree at least, the effect which was foretold, upon the South Devon, in the neighbourhood of Teignmouth. During the Sunday night and the whole of Monday there was a complete gale; the rain falling in torrents, and the waves dashing upon the shore with unusual violence. The effect was to damage considerably a portion of the sea-wall between Dawlish and Teignmouth, near what is called the Parson tunnel.

SUMMARY.

Notice has been given for tenders to be sent in for laying the rails on the line of railway between Dijon and Chalons. The length of road, with stations, is 150,000 metres (37½ leagues), including the three sections, which, from one point to the other, extend to 68,049 metres. All the works are completed, except the viaduct at the Porte d'Ouche of Dijon, which, from certain difficulties, has heen delayed.—The Gravesend hranch of the South Eastern Railway, recently commenced, is, according to the contract, to he completed for traffic by Christmas, 1847. The works are not heavy either in cuttings or embankments. The Gravesend station is to occupy a central position in the town. The line will run into Rochester about a mile further down.—The foundation-stone of the Menai suspension tunnel bridge has been laid during the month, with little formality, by the contractors and engineers of the district. The work is expected to be accomplished in three years.—A part of the Weymouth esplanade has heen so much injured hy the lash of the sea, during the late gales, that the whole must be taken down and rehuilt.—On the recommendation of the Southampton Water Committee, 150*l.* is to be advanced for trying the Chinese system of boring at the artesian well, that system having heen so effectual, as well as economical, when tried in the South of France. The cost of the necessary machinery will not exceed 20*l.*, and the cost of working 2*s.* 6*d.* a foot.—There is a rumour that it is intended to run the new bridge from the Duke of Northumherland's mansion at Charing-cross, to the bend in the Westminster-road forming the premises of Messrs. Atkinson.—We learn from the *Mining Journal*, that a communication has been made to the Academy of Sciences, respecting an extraordinary improvement in the boring of artesian wells by M. Fauvelle. The process has hitherto heen one of great time, and, consequently, of great expense; for it was necessary, after boring a few inches, to draw up the instrument to clear away the earth, stones, &c., through which it had pierced. By M. Fauvelle's process the boring is never interrupted, for the instrument clears itself, and continues its course of perforation. This is effected hy an injection of water through a hollow tuhe, so contrived as to cause a powerful rush under the borer, and clear away the accumulated contents by driving them to the surface. The injection is produced hy a force-pump, worked simultaneously with the instrument of perforation. Our readers must conceive at once that the labour of boring is greatly accelerated by this process, for not only is it unnecessary to disconnect the horer from time to time, in order to clear it, but the cutting point is kept continually free. The account given of the success of this new invention would be regarded as fabulous, if it were not well authenticated. We are assured that at Perpignan M. Fauvelle bored, in the presence of M. Arago, to a depth of 170 metres, for an artesian well, in the short space of 15 days; whereas workmen have been engaged in the same town in making an artesian well of the same depth for the period of 11 months, and their lahours have not yet been completed. This is certainly one of the most valuable discoveries of the present age, for it will enable private persons to make artesian wells at even a smaller expense than common wells, and to go to such a depth as to obtain pure water for domestic purposes. We hope to hear of the experiment being repeated, and that, too, upon an extensive scale.—Although the Cambridge Paving Commissioners had not only agreed to repair the old bridge at tbe back of St. John's College, but to reconstruct it altogether, on an improved principle too, an amended resolution to "request the clerk to ascertain to whom the bridge belongs," is likely to retrograde the whole of this rather ludicrous affair to the old stumbling point for at least another winter; the clerk having "failed to discover the proprietors of the same."—There appears some hope of Lincoln Cathedral being now cleared of the old erections which conceal the greater portion of its outline.—The corporation of Balby have already so far honoured the credit done their liberality hy apportioning part of a field for the site of Miss Banks's church. A subscription of £499 has also been secured.—The Manchester Town Council have been meritoriously engaged of late as pioneers in the good work of sanatory improvement. Cottage owners in the more densely populated localities have been compelled, under the local act, to make better provision for the convenience and decency of their tenants; courts and alleys have been ventilated, and the proprietors of new buildings have heen compelled to provide their tenements with all necessary appendages, the town undertaking the due cleansing of outhouses, &c.—The new church of St. Paul, Alnwick, erected hy the Duke of Northumberland, was consecrated on Friday, the 16th ult.; and the new church of St. Stephen, at the north-east end of South Shields, on the 14th; both by the Bishop of Durham.—The Lords of the Treasury have agreed to advance £50,000 towards the construction of a floating dock at Limerick.—Contracts have been entered into by the Chester and Holyhead company for the construction of the tuhular bridge across the river Conway, and also for the greater portion of that across the Menai Straits, which is to he called the Britannia. The Conway hridge is to he finished in eight months. It is 400 feet span; the Britannia being 450, while the greatest span of any rigid hridge hitherto executed is 240.—The inner part of tbe Maksure at Constantinople has become for the first time accessible to European eyes.

RAILWAYS.

*Means of Communicating with the Guard in Railway Trains.*—The death of a passenger during his railway transit from Swindon to Cirencester has led to the suggestion that passengers might communicate with the guard by means of cords and weights, numbered or ticketted according to the position of the carriage in the train, with which they may be easily connected, while the guard might have facility of access to all the carriages by a kind of enlargement and inclosure of the present footboards, so as to form a railed passage round the whole train. A small shaft running along the top of the carriages provided at each end of each carriage with two universal and one telescope joints, as recommended in a previous number of the *Artizan*, would be more perfect in its action than a cord. On the Greenock railway the guard collects the tickets while the train is under weigh—a platform being affixed on the outside of the carriages on which he can walk. A case has been lately noticed in most of the papers in which a gentleman was attacked by a madman, who happened to be his fellow passenger, and had to make his escape into another carriage while the train was in motion, at the imminent hazard of his life. A correspondent of the *Morning Herald* under the date of October 7th, relates the following case which furnished another proof of the necessity of some ready method of communicating with the persons in charge of the train.—"A lady took her place in one of the first-class carriages by the one o'clock train from Dover. Having fallen asleep, she was awakened by a strong smell of something burning, and was greatly alarmed by discovering that her dress was on fire. She made immediate and successful efforts to extinguish it. There were only two other ladies in the same carriage, who were of course in the greatest alarm. The cause arose from a hot cinder falling on the lady's dress. Upon the guard being afterwards made acquainted with the circumstance, he could only account for it by supposing that the cinder had been thrown up into the carriage by the rapid action of the wheel. Whatever the cause, escape or assistance was equally hopeless." How long must these things be? We fear as long as the public will endure them.

*Continental Railways.*—The largest railway station in France is that of the Orleans Railway at Paris: it covers a space of 249,021 square mètres. The station of St. Lazare at Paris, for the St. Germains, Rouen, and Versailles Railway, covers a space of 34,700 square mètres; great additions are being made. The great central station at Malines covers 130,000 square mètres. The largest station in England is Bricklayers' Arms, on the London and Dover line; it covers 68,700 square mètres.

*Railway Subscriptions.*—From a list in the *Commercial Magazine* it appears that the number of clergymen who signed railway deeds was 257. Of these the greater number are for comparatively small amounts, of from 2,000*l.* to 5,000*l.*; but some have gone into the speculation more extensively. Thus one is a subscriber for 26,000*l.*, one of 27,500*l.*, three of 20,000*l.*, and upwards, six of 15,000*l.* and upwards, ten of 10,000*l.* and upwards, fifty-three of from 5,000*l.* to 9,000*l.*, and the remainder from 2,000*l.* to 5,000*l.* The members of Parliament are subscribers for much larger sums, and are 157 in number, being nearly one-fourth of the Commons. We have one for 291,000*l.*, another 178,600*l.*, another 153,000*l.*, another 144,000*l.*, with two for nearly 120,000*l.*, and many for from 20,000*l* to 80,000*l.*

*The Great North of England, Clarence, and Hartlepool Junction Railway.*—This line has been opened, and is only about eight miles in length, but it forms the connecting link between the York and Newcastle and Clarence Railways, and affords the best and shortest medium for the transit of the coal and iron of the western parts of the county to the important port of Hartlepool. Mr. George Hudson, on behalf of the Newcastle and Darlington Railway Company, had agreed for the purchase of this railway, together with the line, docks, and other works belonging to the Hartlepool Dock and Railway Company.

*Opening of the First Railway in the Kingdom of Poland.*—The line from Warsaw to Petrikau has been opened for public traffic in the presence of the viceroy, Prince Paskewitch. The distance of 19½ Polish miles (109 kilometres), has been performed in four hours, comprising some delays occasioned by the festival occasion. This line will be of great importance to Poland, as it will bring Warsaw within a few miles of the Prussian Silesia, which is already traversed by the Breslau-Berlin line, which again passes close to the Austrian frontier.

*The Trent Valley Line.*—The contractors on this line have the tempting bonus of £10,000 a month held out to them by the directors for every month saved in the time contracted for the completion of the railway, which is therefore expected to be opened in January next, instead of May. Speaking of this, the *Builder* says:—"The directors will be much to blame, we should think, for any accident which may ensue from the hasty and imperfect construction of their works. Such greed of gain on both sides is no doubt one of the causes of so much disturbance in the progress and stability of works."

*Dredge's Patent Bridge.*—The proposed bridge, on this principle, at Western-super-Mare, to connect the island of Burnbeck, and the proposed pier at the end of it, with the main land, is to be 1,100 feet long and 17 wide; centre span 550 feet; outside openings 275 feet, at an estimated cost of £10,000.

SUMMARY.

A letter from Breslau, says that for the previous eight days 100 acres of the extensive peat grounds of Nimkau, which skirt the railroad in Upper Silesia, had been on fire, sending forth a dense black smoke. All efforts to extinguish the fire had been found unavailing.—Germany has now open to public traffic 37 lines of railroad, extending a length of 469½ geographical miles. There are at work on those lines 600 locomotive engines, of which 267 are of English construction, 39 American, 46 Belgian, 16 French, and the remainder German.—The first locomotive ever constructed in Hanover has just been handed over to the Hanover line. It was built in the workshop of M. George Egestorff, at Linden, and has been named Ernest Augustus. Its first trial was on the late occasion of the inauguration of the section of the line from Hildesheim to Lehrte, when the engineers present expressed their admiration of its working.—A letter from Christiana (Norway,) dated the 14th of September, states that Mr. Stephenson, the engineer, appointed by the Company to make surveys for a net-work of railways in the province of Aggershuns, has announced to the Minister of the Interior, that very speedily two engineers will arrive from London, and, in conjunction with himself and M. Raederer, Lieutenant of the Royal Corps of State Engineers, immediately commence preliminary operations.—The opening of the Havre and Rouen Railway for the transport of merchandise is announced for the beginning of November.—At a recent meeting of the Aberdeen Railway Company, the directors stated on the authority of Mr. Cubitt, the consulting engineer, who has been in Scotland inspecting the works, that the line will be opened next spring from the junction with the Arbroath and Forfar Railway to Montrose, and it will be opened throughout in the beginning of the following year. At the meeting, a proposal was submitted to authorise the directors to borrow 276,660*l.*, on terms of the Act of Parliament. This they will be in a condition to do on the 20th of December next, after which period no further calls will be made. Four per cent. will be allowed on all paid-up calls, and as interest has been allowed on all calls paid in advance, the directors have not only received notice of very large sums being about to be paid in this way, on the remainder of the uncalled up stock, but have already received 14,000*l.* in advance. With regard to the accident on the works, caused by the falling in of three arches of the viaduct at Aberdeen, by which nine lives were lost, the report of the engineer states, that apart from the loss of life involved in it the accident was of no importance, and will not in any way retard th' final completion of the undertaking.—A slip has occurred in one of thee cuttings of the Brighton and Hastings, at Pevensey, through the blue clay and green sand. One side of the cutting subsided, filling up the hollow, and carrying the rails to the opposite side. 40,000 cubic yards of earth will have to be removed.—Mr. Brunel, according to the *Western Luminary*, has ceased to be the engineer of the Bristol and Exeter. This fact, coupled with what transpired at the last half-yearly meeting, may be taken as an indication that the interests of the company have ceased, in the judgment of the directors, to be so far identical with those of the Great Western, as that both may be efficiently promoted by the same engineer. In all probability we shall have three competitors for a direct line to London in the next session. The Great Western, the South-Western, and the Bristol and Exeter Companies will have each its separate project; and there will be no independent company in the field.—In little more than twelve months, it will be possible to be able to start from the metropolis after breakfast, and having travelled the immense distance of 500 miles, reach Aberdeen in time for supper.—Messrs. Jackson and Co., are stated to have obtained from the Pope the concession of a railway from Bologna to Rome and Civita Vecchia. English capitalists are to have six-ninths in the enterprize, Baron Torlonia two-ninths, and the Roman Bank one-ninth. The capital was fixed at 25,000,000 scudi (3,000,000*l*).—A viaduct of twenty-eight arches is to be constructed over the Tweed at Berwick for the Newcastle and Berwick Railway.—The expense of opposition to the North Staffordshire line amounted to no less than 74,371*l.*, besides legal and engineering charges amounting to nearly as much, namely, 66,473*l.*—A deputation representing the South-Western, and consisting of Mr. Chaplain, the chairman, Mr. Campbell, the secretary, and others are now visiting all the towns on the route of the proposed line from Salisbury to Exeter, and from thence to Falmouth, calling on all the landowners whose property will be interfered with by the line, and also on all the principal inhabitants of the towns by which it passes, and, by endeavouring to meet their wishes, to economise the parliamentary expenses in the next seseion.—A train of merchandise lately left Manchester for Crewe, composed of 101 waggons. Its gross weight was 600 tons, and its length 1,550 feet. The distance, 30 miles, was accomplished in two hours nine minutes, being at the rate of 14 miles per hour, over gradients varying from 1 in 377 to 1 in 330.—A letter from St. Petersburg states that the works on the railway to Moscow are proceeding rapidly, and that this grand communication will probably be opened in 1847.—The Irish papers state that the Lords of the Admiralty, under the sanction and advice of Lord John Russell, have determined upon making the Cove of Cork a naval station.—The Dutch papers state that the railway from the Hague to Delft has been opened by a train which went to that place and back for the first time by way of trial, which was perfectly satisfactory.

### ENGINEERING.

*Court Martial on the Engineers of the Hecla.*—We have received the notes of the court martial recently held on board H.M. S. *Tyne*, at Malta, for the purpose of trying the engineers of the *Hecla* accused of insubordination when the vessel had been at Constantinople three months before. It seems that Lieut. Hire, the first lieutenant of the *Hecla* had, without previous communication with the engineer, ordered the engine-room forge to be taken from the engine-room, and placed on the forecastle for the use of the ship, and when Mr. Johnstone, the first engineer, some time afterwards found it there, he ordered the stokers to take it below, and he subsequently refused to let the lieutenant have it again without a written order from the captain. The lieutenant reported this circumstance to the Captain, who "dared the engineer to disobey the order of the first lieutenant;" but the engineer was inflexible, and said he would obey no orders but those of the captain himself, and that he expected a written order before he would remove the forge from the engine-room, to which department it belonged. The Captain no sooner learned this determination than he ordered the first engineer to be put under arrest, and then sent for the second engineer to give into his charge the management of the engines, but the second engineer declined the charge, on the ground that he was not competent for the office, having been turned back when attempting to pass his examination as first engineer at Woolwich. The second engineer, for this expression of incompetence, was ordered under arrest, and the third engineer, who also declined the duty, was similarly treated. The sentence of the court martial was that the first engineer should be discharged from the *Hecla*, be mulct of all pay and allowances due to him, and be reduced to the rank of second engineer for 12 months, with the recommendation that he should be reinstated in his former rank at the expiration of that time, if his conduct were approved of. The second engineer was liberated on account of a flaw in the indictment, and the third engineer was sentenced to be mulct of all pay and allowances due to him, and sentenced to be continued in his present rank without possibility of promotion for a year. The first engineer is now kept on board the admiral's ship *Ceylon*, at Malta: he is sent ashore every morning under a strong guard to work in the dock-yard, where he is kept working like a felon all day, is taken to and fro for his meals, and has to be on board every night by nine o'clock. We have here a specimen of the usage men may expect who enter the navy as engineers. Mr. Johnstone, the first engineer of the *Hecla*, is admitted on all hands to be a most respectable and efficient man. He took away the forge because it had previously been damaged by some of the sailors who had the use of it at Constantinople, and he no doubt thought it a most irregular thing and subversive of all discipline and subordination if the implements in his custody, and for the care of which he was alone responsible, shonld be taken from the engine-room without his sanction or cognizance. The second article of the code of "Instructions to be observed by the Engineers of the Navy," published at page 244 of the third volume of the *Artizan*, specifies that the engineer "is to take charge of all engineers' stores and tools, and to be responsible for the due care of them," and here we have a man put under arrest and condemned by a court martial to punishment for conscientiously carrying out the Admiralty's own orders, and which, had he failed to execute, would have left him open to just reprehension. Article 20 of the code of engineers' instructions provides that "the engineer is on no account to disobey an order he may receive from his commanding officer," and Mr. Johnstone distinctly said that he was willing to obey the order of his commanding officer whatever it might be, but he required that order be given in writing to exonerate him from blame, should the forge or any of the other implements committed to his charge be damaged or destroyed, and of which he appears to have had a natural apprehension. It appears to us, therefore, that the engineer was not only justified in pursuing the course he took, but that any other course would have been an infraction of the rules laid down by the Admiralty for his guidance, and it further appears to us that Lieut. Hire departed both from the letter and spirit of his instructions when he obtruded himself into the engine department to take away tools or give orders, as if his object were to bring the authority of the engineer into contempt. Article 22 of the engineers' regulations states that "the chief engineer is to be responsible for the general decorum and good order of the engine-room," but wherein can he be responsible if his regulations are to be upset and his authority reduced to nought by every young gentleman of the quarter-deck who is bursting to swell himself into a giant. The Admiralty's order to Captains expressly states, that where the men in the engine-room are to be interfered with, "the order is to be given through the senior engineer on duty at the time," so that even the Captain is not to interfere with the stokers when the vessel is under steam, without conveying his orders through the engineer. What, then, shall be said of a mere lieutenant who, *without* communicating with *any* engineer, penetrates, on his own responsibility, into the engine-room in quest of prey, and how can the engineer be sure that parts of the engine may not be carried off, as well as forges ravished, if the depredations of such interlopers are to be permitted? Next month we shall have more to say on the subject.

### MISCELLANEA.

The extensive cotton mill of Messrs. W. Bayley and Brothers, at Staleybridge, near Ashton-under-Lyne, whose firm employs upwards of 1000 persons has been destroyed by fire. The fire broke out in the second story of the large warehouse adjoining the factory, in which were from 9000 to 10,000 pieces of calico, besides a large quantity of twist, waste, &c. Such was the rapidity of the fire, that the building, which is three stories high, and seven windows in length, was, in the course of about two hours from the time of the fire being found out, completely gutted, the whole of the interior being destroyed. It is generally supposed that the fire must have originated from spontaneous combustion. The whole of the 10,000 pieces, together with every other article, was destroyed, save the burning remnants of the cloth which were carried out by the men who daringly ventured their lives for the purpose. The estimated damage of the stock is 2500*l.*, which, with the destruction of the building, will be between 3000*l.* and 4000*l.* Both the building and stock is insured in the Phœnix fire-office, but the insurance will scarcely cover this amount.—In Belgium and the North of France the potato crop is reported to be not only good, but abundant; the unsound crop of last year being succeeded by one perfectly healthy.—The directors of the Manchester Commercial Association, together with a few of the members more intimately connected with India, have had a lengthened interview with D. C. Alywin, Esq., of London, on the subject of the salt monopoly of India: the injurious and oppressive nature of which was very ably and fully pointed out by that gentleman. Mr. Alywin's statement was discussed in all its bearings by the members of the Association present, and the further consideration of the subject was deferred until the next meeting. The annual value of the mineral produce of this country amounts to about twenty-five millions. Of this 9,100,000*l.* is from coals, 8,400,000*l.* from iron, 1,200,000*l.* from copper, 920,000*l.* from lead, 400,000*l.* from salt, 390,000*l.* from tin, 60,000*l.* from manganese, 35,000*l.* from silver, 22,000*l.* from alum, 8000*l.* from zinc, and 25,000*l.* from the various other metals, as antimony, bismuth, arsenic, &c.—A very considerable quantity of Admiralty records have recently been transferred into the custody of the Public Record Office. The documents are now in progress of transfer from the Dockyard at Deptford to the White Tower of London.—The *Cambria* and the *Great Britain* quitted America on the same day; great interest was felt as to which would perform the voyage in the shortest period, as one is worked by the paddle and the other by the screw. The *Cambria* came from Boston in 11 days; the latter took 13 days and 8 hours to come from New York, but of this period 18 were consumed in repairing the driving chain.—Letters from Trieste announce that the harvest on the banks of the Danube and on the shores of the Black Sea has been excellent. "We have not," says the writer of one of these letters, "to join the rest of the world in deploring the scarcity of corn; for a letter of the 19th ult. from Galatz, states that 700 vessels have left the Bosphorus with a favourable wind from the south, bound for the ports of the Black Sea and the Danube. The quantity of corn in store is so great that a sufficient number of transports cannot be found, although they have everywhere been sought for."—No less than three hundred informations were laid last week against the owners of tenements in Liverpool for cellars which were either defective as respects ventilation, or were of insufficient size for human dwellings.—The spinning factory of M. Damiens, at Rouen, has just been burned to the ground, with the exception of the building in which the Director lived. The fire broke out at nine at night, and lasted until three in the morning. Not less than 150 workmen are thus thrown out of employment. The property was insured.—A vessel has arrived in the Regent's Canal from the Greenland seas, with a cargo of ice on board which, may be computed to have comprised from 300 to 400 tons weight of the article.—Some experiments were lately made at Mentz, in presence of several members of the Military Commission of the Confederation, with the cotton powder invented by M.M. Schönbein and Boelcher, and of which so much has been said. The experiments were perfectly successful. It has, it is said, been proposed to the Diet to award a handsome sum for the communication of the secret, leaving the inventors the power of taking out patents for it in foreign countries.—The mill operatives of the various manufacturing districts, after submitting to Mr. Charles Hindley, M.P., at Manchester, the present position of their trade, have determined to work short time, and at a meeting of delegates held last Sunday, a memorial on the subject to the employers was agreed upon.—In consequence of the extraordinary extension of the Goodwin Sands in the direction of the "Bunt Head," it has been found necessary to move the light vessel half a mile further to the westward, in order to cover the shoal; and the buoy that marks the extreme end of the Bunt Head, sixty fathoms further in a south-westerly direction. A shoal has also sprung up in the Gull Stream, in the direct track of the navigation.—A letter from Alexandria, of the 29th ult., says, "The Viceroy is in perfect health, and will leave for Cairo in a few days. Ibrahim Pacha is still at a village in Upper Egypt, where he is gone to set up the machinery he has had brought from Paris."—The workmen of the Llynvi Iron Company have given Dr. Bowring, the Chairman, a salver, in gratitude for his abolition of the truck system.—The Admiralty are most busily occupied in devising measures for efficiently and most speedily manning the fleet on an emergency.

# THE ARTIZAN.

No. XXIV. —New Series.—DECEMBER 1st, 1846.

## Art. I.—COURT MARTIAL ON THE ENGINEERS OF THE HECLA.

In conformity with the intention we announced last month, we now proceed to lay before our readers the notes of the court martial lately held upon the engineers of H.M. S. *Hecla*, at Malta, in consequence of the refusal of the first engineer to give up the engine-room forge to the first lieutenant, and of the second and third engineers declining the performance of the first engineer's duty, for which they alleged themselves unequal. Engineers cannot but feel this whole trial to have been a perfect mockery, and indeed any trial of an engineer in the navy at the present time cannot well be otherwise. Who are the judges? The very class whose prejudices they have offended, and between whom and the engineers an hereditary feud has subsisted from the moment of the introduction of steam power into the naval service. It is impossible not to feel that the sentence would have been a very different one had engineers, instead of nautical men, occupied the seat of judgment; and even we, who, as our pages can testify, are by no means backward in reprehending the conduct of engineers when there is occasion, are bound to say that our award would have been a very different one from that which dooms Mr. Johnson to degradation. We have yet to see in what way it can be made conducive to the efficiency of the naval service to degrade and imprison a respectable man for the conscientious performance of his duty, and those judge very precipitately who suppose that such acts of presumptuous tyranny can be practised without bringing a heavy retribution. What! do these naval autocrats imagine that it is serfs they have to deal with? or that engineers are the same primitive and tractable race as seamen, whom they long have oppressed with impunity? Engineers are members of a large and powerful body of working men, who, by combination, are always able to make their power felt, and with whom the majority of the other trades will coalesce if only moved thereto by some crying injustice; and the officers of the navy appear in every way disposed to afford to such a combination the necessary incentive. If the Admiralty acts wisely, it will annul the sentence of the Court Martial, and restore Mr. Johnson to his rank and liberty, for every unprejudiced person must see that it is Lieutenant Hire, and not Mr. Johnson, who is the guilty party: *but if the wrongs of these engineers be suffered to remain unredressed—if the Admiralty identifies itself with a decision that makes it clear to all the world that for naval engineers there is no justice, and that the conscientious performance of their duties may be visited as a crime at the caprice of any nautical pretender—then the Admiralty must be told that the only other appeal that will be made is to its fears; and a conflict will be begun of a far more serious nature than can now be conceived by drowsy officials.* At present an inconvenience is felt in obtaining engineers for the navy, and such an inconvenience need not be experienced under a proper system: but this is a mere indication of the perplexities that will arise if the present system be persevered in. What would the Admiralty do if not a single engineer could be found to enter one of their vessels while a European war was impending? Impressment would certainly be impossible in such a dilemma, as the whole trades in the kingdom would rise up to resist the attempt; and even if persons could be induced to enter upon the performance of the engineers' functions who were not themselves engineers, on the supposition that a little practice with appropriate instruction would enable them to work the engines, they would not only in the meantime do the work badly and damage the machinery by their want of skill—rendering vessels unserviceable, perhaps, when they were most wanted—but would soon come to make the very demands now made by the engineers, and the refusal of which would drive them into the ranks of the malcontents they have succeeded. It is altogether a vain expectation which some navy men indulge, that the claims of the engineers may be met by bringing into their place another clase of persons: the same circumstances would create among these new comers the very same wants; and the result would be, that the demands which are now resisted would have to be conceded to less elegible servants. The Admiralty has already tried many ways of reconciling the maintenance of its present system with the possession of good engineers and smooth working in the service. Those expedients have all failed, and what length of time is supposed to be requisite for such an experiment? Fact as well as reason proclaims that the desired results are not to be realized by the perpetuation of a great moral wrong—though in this, as in most other cases, the desired amelioration must, we suppose, be rather extorted by force than gained by any appeal to fact or reason. For this issue we are prepared; it is to be hoped the Admiralty has been equally provident.—But we have not space to continue these generalities. We therefore proceed to lay before our readers the evidence in this case as given in the *Malta Mail*, and commend it to their patient attention:—

On Monday, October 7th, a Court Martial assembled on board H. M. S. *Tyne* for the trial of William Johnson, first engineer of H. M. steam sloop *Hecla*, David Douglas, second engineer of the same vessel, and Charles Wright, third engineer, on the following charges:—

As regards the first named prisoner, for contemptuous conduct, he having refused to allow a forge to be sent on deck for the use of the ship, without a written order from the captain, he having been ordered to do so by Lieut. Hire, and also by his captain,—and disobedience of orders to the captain and first lieutenant of the *Hecla* on the 1st of June last, he having, on being placed under arrest, turned half round and said to his captain, "I thank you very much, sir,"—and for disobedience of orders as regards the two last-named prisoners, they having separately refused, on being ordered frequently so to do, to take the charge of the engines and engine-room of the *Hecla*.

The Court was composed of

| | | |
|---|---|---|
| Captain W. N. Glascock, | *Tyne* | President. |
| " F. Stopford, | *Amazon* | Members. |
| " W. J. Williams, | *Avenger* | |
| Com. F. P. Le Hardy, | *Fantome,* | |
| " Douglas Curry, | *Harlequin.* | |

W. H. Brown, Esq. Paymaster and Purser of H. M. S. *Ceylon* officiated as Judge Advocate.

The prisoner William Johnson having been placed before the Court, the proceedings commenced by Captain Duffil calling the following witnesses to make good his charge against the prisoner.

Lieutenant Henry William Hire examined by Captain Duffil.

Captain Duffil.—Is the prisoner Johnson first engineer of the *Hecla*?—Yes.

Capt. Duffil.—Did you on the forenoon of the 1st of June last, when lying at Constantinople in the *Hecla*, order the forge to be got on deck?—I did.—By whom was it taken up, by the stokers, or by any other of the crew?—Not by the stokers; I can't mention mens' names, but the carpenter, Mr. Thompson, and the Bombardier of Artillery, who was going to work, got it up with assistance of others.—Where was it placed when got up?—On forecastle, starboard side.—Did you make any report to me on that morning on the conduct of the first engineer, Mr. Johnson, the prisoner?—I did.—State the nature of report, for information of this Honourable Court.—I told Captain Duffil that I had ordered the forge to be got up on the starboard side of the forecastle; I had seen it there, and during my alsence to the *Duke of Cornwall*, the officer of the watch, Lieutenant Jackson, had reported to me on my return that Mr. Johnson, chief engineer, had ordered the forge to be taken to pieces, and struek down into the stoke room.

I sent for Mr. Johnson, and on going to the stoke-hole-hatch I asked what they were doing with the forge—I was answered they were stowing it away; on Mr. Johnson coming aft I told him the officer of the watch had reported to me that he had taken the forge off the forecastle knowing well it was placed there by my order; I then told him the forge was to be got up immediately and placed in the same position where I left it on the forecastle.

He told me—No Sir.—the forge was not supplied for the ship's use—that he did not want to use it himself, and nobody else should.

I told Mr. Johnson I wanted nothing to be said on that subject but to go and obey my orders—he said "Sir, I will not"—After what had occurred I reported the circumstance to Captain Duffil. He came with me to Mr. Johnson, and turning round to me, said "Let me hear you order Mr. Johnson to get the forge on deck,"—I did order him; he made the same answer to Captain Duffil that he had done to me. Commander Duffil said, "Mr. Johnson, at your peril, disobey the order of the first lieutenant," and went away, calling me after him. I went. He then, being aft, requested I would come down to his cabin: at the same time I told the officer of the watch to see that the forge was got up.

On going to his cabin, Captain Duffil was sitting down; he said "I am at a loss to imagine what can induce Mr. Johnson to behave himself thus; it is better for you to come away and give him a chance of obeying the order, but whether he does so or not, I shall report his conduct to the Admiral on my arrival at Malta."

Mr. Jackson at that moment came to the cabin, and reported that Mr. Johnson, chief engineer, had decidedly and distinctly refused to obey his orders: Captain Duffil went on deck, Lieutenant Jaekson and myself following, and, sending for Mr. Jackson, Captain Duffil said, "You disobeyed the orders of two lieutenants, and appear to bid defiance—go and get the forge up immediately." He (Mr. Johnson) was making some reply, when Captain Duffil said "You hear my order—let it be obeyed," or words to that effect.

Mr. Johnson turned round and said, "No, sir, not unless you give me a written order," and repeated it once or twice, when Captain Duffil ordered him off deck into close arrest. As he was going away he turned half round and said, "I thank you kindly, Captain Duffil."

Capiain Duffil.—Did you hear me give the officer of the watch orders, previous to my going below, to see that the prisoner, Mr, Johnson, took the stoker's and got the forge up?

Lieutenant Hire.—I did; and I repeated the order to the officer of the watch.

Captain Duffil.—Did you hear me, previous to that time, when I left the deck, give Mr. Johnson, the prisoner, the order to take the stokers and get the forge up?

Lieutenant Hire.—Captain Duffil said to Mr. Johnson, "I order you to take the stokers and get the forge up on deck, and disobey the orders of the first lieutenant at your peril."

Examined by Captain Glascock.—On any other occasion did you ever order the forge in question to be brought on deck for the ship's use.

Lieutenant Hire.—Yes, ever since I belonged to the ship.

Captain Glascock.—Had you ever heard, or had it been a practice, that the forge had been brought on deck for ship's use?

Lieutenant Hire.—The forge has also been used for ship.

Captain Glascock.—How are you cognizant of that circumstance?

Lieutenant Hire.—Because I asked the carpenter where his forge was, shortly after joining; he told me there was only one in the ship, which served both purposes, which was in charge of the engineer.

Captain Stopford.—Had Mr. Johnson ever before made any objection to the forge being used for ship's use?

Lieutenant Hire.—Never; on one or two occasions, when the forge had been in use for ship, he came to me and said he wanted it for the engine-room, when it was given up to him; this occurred *twice* to the best of my recollection.

Captain Stopford.—Do you happen to know if this forge was required on that day for the engine or engine-room?

Lieutenant Hire.—To the best of my knowledge, decidedly not.

Captain Stopford.—You said the carpenter had told you that one forge served both purposes, and that was the engineers'—do you know if the carpenter had ever had a forge in charge, one fit for use?

Lieutenant Hire.—To my own knowledge, since I belonged to her, there has only been one in the ship. Have been told the other was never drawn.

Captain Stopford.—How long have you been in the *Hecla?*

Lieutenant Hire.—About 22 months.

Captain Stopford.—What duty did you do on board during that time?

Lieutenant Hire.—The duty of Senior Lieutenant.

Captain Stopford.—Had the forge ever been injured in ship's use, so much so that the engineers had difficulty in doing their work with it?

Lieutenant Hire.—Not to my knowledge.

Captain Stopford.—What was Mr. Johnson's manner to yourself on the occasion of his refusal to comply with orders?

Lieutenant Hire.—I should say careless and disrespectful to me.

Captain Stopford,—What did you think his manner was when Captain Duffil gave him orders?

Lieutenant Hire.—Decidedly disrespectful; and, when placed under arrest, the answer he made, as well as his bearing on the occasion, was contemptuous.

Captain Stopford.—Has Mr. Johnson been first engineer of the *Hecla* all the time that you have been first lieutenant?

Lieutenant Hire.—He has.

Captain Stopford.—What answer do you allude to?

Lieutenant Hire.—He was standing about a yard off Captain Duffil, on leaving him. When Captain Duffil had placed him under arrest he had taken about three steps, and, with a sort of half swing, turning partly round, said, "I thank you kindly, Captain Duffil." Cannot remember if he said it sneeringly. but it was highly contemptuous. I repeat it was said contemptuously.

Commodore Curry.—In whose charge was the forge?

Lieutenant Hire.—Under charge of the first engineer till some day of April, and on the expense books being brought me to sign, I found it had been expended.

*Examined by Prisoner.*

Prisoner.—Have you not generally been in the habit of asking me if you could have the forge?

Lieutenant Hire.—Yes.

Prisoner.—Did you not get particular orders on the 1st of June that the forge should not be taken from the store without my being made acquainted thereof?

Lieutenant Hire.—No. I gave the usual orders to the carpenter to get the forge up to make good its defects. Mr. Johnson was on shore that morning.

Captain Williams to Lieutenant Hire.—Why, before getting up the forge, did you depart from your usual custom of previously consulting the first engineer whether the forge would be wanted for the engine?

Lieutenant Hire.—I believe him to have been on shore.

Captain Williams.—Why did you not consult the second engineer?

Lieutenant Hire.—I never had done so.

Captain Williams.—So. when the first engineer is out of the ship, the second engineer, or he in charge of the engines, you have not been in the habit of consulting?

Lieutenant Hire.—No.

Commodore Curry.—You stated that the first engineer slept on shore; was he perfectly sober when this took place?

*Court cleared to consult on the propriety of question (overruled).*

Commodore Curry.—You stated you believe that the first engineer slept on shore the night before; at what hour did he report himself on the 1st of June?

Lieutenant Hire.—To the best of my belief he was out of the ship. Cannot remember.

Commodore Curry.—Do you remember giving him leave to go ashore?

Lieutenant Hire.—I might or might not; I do not remember.

Commodore Curry.—At what hour of the day was it when you first ordered up the forge?

Lieutenant Hire.—Between 7 and 8, a.m., I believe.

Captain Williams.—What grounds had you for believing the first engineer slept out of his ship?

Lieutenant Hire.—His general habit of being always on shore.

Captain Williams.—Was he in the habit of going on shore without previously receiving your permission or that of the commanding officer?

Lieutenant Hire.—No.

Lieutenant William F. F. Jackson, H.M. Steamer *Hecla*, examined.

Captain Duffil.—Were you officer of the forenoon watch on 1st June last, when the *Hecla* was lying at Constantinople?

Lieutenant Jackson.—I was.

Captain Duffil.—Did you hear me give any orders to the prisoner, Mr. Johnson, first engineer? if so, state to the Court what you heard.

Lieutenant Jackson.—Heard Captain Duffil, in presence of Lieutenant Hire, order Mr. Johnson to get the forge up; and he (Captain Duffil) asked him why he refused to obey the order of Lieutenant Hire. Johnson replied, that he could not get the forge up without a written order from Captain Duffil. Captain Duffil ordered him two or three times to do it, saying, "Refuse to do it at your peril; obey my orders." Captain Duffil left the deck with Lieutenant Hire, ordering me as officer of the watch to see it done. Shortly after, the carpenter asked me if I would give him a direct order to go into the engine-room, as he did not like to go into Mr. Johnson's department; Mr. Hire, before leaving the deck. ordered the carpenter to get the forge up: there was work going on at the time on deck; I told him (carpenter) to wait a few minutes and I would see to it. About ten minutes after, I called on Mr. Telfer, the midshipman of the watch, to listen, while I sent for Mr. Johnson, to hear what I had to say.

I sent for Mr. Johnson, and ordered him to get the forge up, with the stokers of the watch; he said he could not, and began walking away. I called him back, and said, "Do you refuse to obey my order as officer of the watch?" he said, "I do, I cannot get the forge up without a written order." I called Mr. Telfer's attention to it, went below, and reported to Captain Duffil, who came on deck, and ordered prisoner to be put under arrest. As prisoner was walking away, he said something which I did not hear; Mr. Hire called my attention to the expression made use of.

Examined by Captain Glascock.

How long have you been a lieutenant on board the *Hecla?*

Lieutenant Jackson.—Since the middle of May last, I think.

Captain Glascock.—When serving in the *Hecla,* did you ever know the forge to be ordered on deck for the ship's use? I mean the general work of the ship?

Lieutenant Jackson.—I have seen the forge working on the forecastle with two men, not stokers. I never heard it ordered.

Captain Glascock.—Did you ever know the prisoner to object to the forge being used before the 1st June, 1846?

Lieutenant Jackson.—No.

Captain Glascock.—You have stated that you were on deck when the prisoner refused to comply with the orders given by Commodore Duffil. Was his manner contemptuous or not to Captain Duffil?

Lieutenant Jackson.—It was.

Captain Stopford.—Was the forge rigged on the forecastle when you relieved the deck on the morning of the 1st of June?

Lieutenant Jackson.—I do not remember.

Captain Stopford.—Did you see it brought up after you relieved the deck?

Lieutenant Jackson.—No, sir, but I saw parts of it taken down; I did not see it rigged.

Captain Stopford.—At what time was that?

Lieutenant Jackson.—About 10 o'clock.

Captain Stopford.—Who was taking it down?

Lieutenant Jackson.—The stokers; I do not recollect the names of them.

Captain Stopford.—Was any officer superintending?

Lieutenant Jackson.—Mr. Johnson, who was walking up and down, close to the hatchway, as the forge was going down.

Captain Stopford.—Who was commanding officer of the *Hecla* at that time next to Captain Duffil?

Lieutenant Jackson.—Lieutenant Price.

Captain Stopford.—Where was Lieutenant Hire?

Lieutenant Jackson.—On board the *Duke of Cornwall* steamer.

Captain Stopford.—How soon did he return?

Lieutenant Jackson.—About a quarter of an hour after.

Captain Stopford.—Did you report the circumstance to him directly he came on board?

Lieutenant Jackson.—I did.

Captain Stopford.—Were you present when he sent for the first engineer, and ordered him to replace the forge on the forecastle, or to get the forge up?

Lieutenant Jackson.—I was.

Captain Stopford.—Did you hear what answer the first engineer made to Lieutenant Hire?

Lieutenant Jackson.—Yes: he said he could not get the forge up without a written order from Captain Duffil; also added, he was not under Mr. Hire's orders; he had no business to obey any orders except the captain's, or words to that effect.

Captain Stopford.—Did Mr. Hire then go below to report the circumstance to Captain Duffil?

Lieutenant Jackson.—Captain Duffil was walking the deck, and Lieutenant Hire turned round and reported it to him.

Captain Williams.—Did prisoner make any previous application to you before the forge was taken down?

Lieutenant Jackson.—None.

Captain Williams.—Are you aware whether he made any such application to Lieutenant Price as the senior lieutenant on board?

Lieutenant Jackson.—I am not aware; I do not think he did.

Captain Williams.—You stated that the prisoner said he could not take down the forge without a written order; did he give you any reasons why he wished for such an order?

Lieutenant Jackson.—None, except that the forge belonged to his department, and no one had any business with it.

Commodore Le Hardy.—Who was the officer of the morning watch on the 1st of June?

Lieutenant Jackson.—Lieutenant Douglas.

Commodore Curry.—Did prisoner report to you that morning as officer of the watch as having come from leave?

Lieutenant Jackson.—No.

Commodore Curry.—At what time did you take charge of the deck?

Lieutenant Jackson.—About 20 minutes past 8.

Commodore Curry.—Are you aware if prisoner returned from leave in your watch?

Lieutenant Jackson.—No, sir, I do not believe he did.

Captain Glascock here cleared the Court, which adjourned for half-an-hour.

Captain Glascock to Lieutenant Jackson.—During the period you have served on board the *Hecla* did you ever hear the Articles of War read?

Lieutenant Jackson.—Frequently.

Captain Glascock.—Were all hands mustered aft and reported as aft, and by whom so reported?

Lieutenant Jackson.—All hands were ordered aft, and the master-at-arms reports to Lieutenant Hire that the deck is clear; Lieutenant Hire reports to the captain.

Captain Stopford.—(gives log to the witness Jackson, who reads it, in which the time of arresting prisoners was stated,)—Who put prisoner's arrest in log?

Lieutenant Jackson.—I ordered it.

Captain Glascock.—Did you sign for it?

Lieutenant Jackson.—No.

Commodore Le Hardy.—At what hour do you first remember to have seen prisoner on the 1st of June?

Lieutenant Jackson.—As near as I remember, at half-past ten.

Prisoner.—Did I explain to you that as I was not allowed to use the forge myself without a verbal order, I could not allow any one else to use it without a written order from the Captain?

Lieutenant Jackson.—When I first asked Mr. Johnson at the time the forge was being taken below, if he wanted the forge in the engine room, he said he did, and as he walked away he said in an under tone, "as I am not allowed to use it myself, I will take good care no one else does." I do not remember his saying any thing about a written order.

Prisoner.—When you sent for me the second time, did I not say I would give the forge with pleasure if I had a written order from the Captain?

Lieutenant Jackson.—Most certainly not, he said as I said before, he would not allow it without a written order.

John Buchan Telfer, Naval Cadet, *Hecla,* examined by Captain Duffil.

Had you the forenoon watch on the 1st June last on board the *Hecla,* lying at Constantinople?

Mr. Telfer.—Yes, I had.

Captain Duffil.—Did you hear me give any orders to the prisoner, (1st. engineer of the *Hecla*)?

Mr. Telfer.—Yes Sir, I heard Captain Duffil order the prisoner to get up the forge.

Captain Duffil.—What was his reply?

Mr. Telfer.—No Sir, not without a written order from you Sir!

Captain Duffil.—Was he then, or soon after placed under arrest?

Mr. Telfer.—Yes Sir, soon after.

Captain Duffil.—Did he make any reply to me as he was leaving the quarter deck?

Mr. Telfer.—Yes, sir.

Captain Duffil.—State what the reply was.

Mr. Telfer.—"Thank you very much, sir, that's just what I want, sir." These are the exact words, as near as I can recollect. He said something about sending him over ship's side, but I do not recollect what.

Captain Glascock.—How long have you been in the *Hecla?*

Mr. Telfer.—About 15 months; I have joined since Lieutenant Hire.

Captain Glascock.—Do you remember on any previous occasion the forge having been ordered up by the commanding officer, or that the prisoner ever refused its being used for the service of the ship?

Mr. Telfer.—I have heard Lieutenant Hire say to Mr. Thompson, the carpenter, that he should want the forge up, and told him to get it up, but never knew any case when it was refused for ship's use by the first engineer.

Captain Stopford.—Who was officer of forenoon watch that day?

Mr. Telfer.—Lieutenant Jackson.

Captain Stopford.—Did he send to you at any time during the watch to hear what he said to prisoner?

Mr. Telfer.—No, sir.

Captain Stopford.—Did you hear him give prisoner any orders?

Mr. Telfer.—Yes, sir, he said, "Get the forge up, Mr. Johnson."

Captain Stopford.—Did prisoner make any answer?

Mr. Telfer.—Yes, sir, he said, as well as I can remember, "Nor you, nor any other officer of the ship shall have it without a written order from the captain."

Captain Stopford.—Did you hear any more that passed between Lieutenant Jackson and prisoner?

Mr. Telfer.—Lieutenant Jackson turned round to me and said, "You hear that, Mr. Telfer," and at the same time Lieutenant Jackson said, "Very well."

Captain Stopford.—Do you recollect what time in the forenoon watch this was?

Mr. Telfer.—Five bells.

Captain Williams.—Did you hear prisoner tell Lieutenant Jackson that he would get the forge up with the greatest pleasure if Captain Duffil would give him a written order?

Mr. Telfer.—No.

Captain Hardy.—At what hour on the 1st of June did you first see prisoner on deck or below?

Mr. Telfer.—As well as I can recollect, about half-past 8 on deck.

Colour-Serjeant Charles Hodges called.

Captain Duffil.—Were you on duty on deck on the 1st June last, forenoon, when the *Hecla* was lying at Constantinople?

Mr. Hodges.—I was, part of the time.

Captain Duffil.—Did you hear me give any orders to prisoner on that morning?

Mr. Hodges.—I heard Ceptain Duffil order the first engineer under arrest; he replied, "I thank you much, Captain Duffil," and I was immediately ordered by Lieutenant Hire to confine prisoner to his cabin under elose arrest.

Captain Glascock.—When prisoner replied to Captain Duffil "I thank you much," and when Captain Duffil ordered prisoner under arrest, were the words uttered in a contemptuous tone, and did his manner partake of that bearing?

Mr. Hodges.—In answering that question, or in making answer to Captain Duffil, he put his hand to his eap, and turned round to go away; *neither his manner nor tone struck me as being contemptuous.*

Captain Glascock.—Would you report to your superior officer if a private of your party had answered you in the same manner as the prisoner answered Captain Duffil?

Mr. Hodges.—*I certainly should have reported him for making use of those words,* "I thank you very much."

Captain Glascock.—Do you mean to say that you should report a man for using the words to you, as deeming them disrespectful or contemptuous?

Mr. Hodges.—I should deem them disrespectful.

Captain Stopford.—How long have you been on board the *Hecla?*

Mr. Hodges.—One year and ten months.

Captain Stopford.—Did you ever know prisoner refuse the forge for the ship's use before the ease in question, when required?

Mr. Hodges: No, sir.

Captain Stopford: What duty do you do on board the *Hecla*?

Mr. Hodges: Serjeant of Marines, doing regular duty.

Captain Stopford: Have you ever been doing duty of master-at-arms when the Articles of War were read?

Mr. Hodges: Not that I remember, only occasionally.

Captain Williams: Do you consider an offieer placed under arrest in the light of a punishment inflicted?

Mr. Hodges: All persons put under arrest are placed to await a punishment, or the decision of officers as to the punishment that may be awarded.

Captain Williams: Is it probable that such arrest may lead to punishment?

Mr. Hodges: Too long an arrest is considered as punishment distressing to the bodily frame. It is disrespect, at the least; I do not know whether you gentlemen allow it to go further.

Commodore Curry: Do you know if prisoner and other engineers were always present when the Articles of War were read?

Mr. Hodges: I cannot say if the three are always present.

Commodore Curry: Were they always ordered up when on board?

Mr. Hodges: To the best of my knowledge, I have seen the prisoner when they have been read.

Lieutenant Hire recalled.

Captain Stopford: Since you have been first lieutenant of the *Hecla,* have you heard the Articles of War read on board?

Lieutenant Hire: I have; they are generally read on Sunday.

Captain Stopford: What reports are made to you as to people on deck and what reports do you make to Captain Duffil?

Lieutenant Hire: We muster at divisions; they are reported present to the captain by officers; the captain inspeets divisions, and on going below to the after part of the ship, orders the men to fall in, port side, as they muster in the ship's books. After inspecting the ship, the master-at-arms reports to me that the stewards and servants, in fact, every person is present, and I report the same to the captain; the Articles of War are then read; on being finished, the ship's eompany is mustered by officers; the ship's company on the port side; marines at starboard gangway; on the after part of the quarter-deck commissioned and subordinate officers; by the main-mast are warrant officers and engineers, and boys down the skylights.

Captain Stopford: Are engineers ordered to be on deck at divisions on Sundays?

Lieutenant Hire: In harbour they are; at sea the engineer of the watch works below, and the first engineer takes his place when the captain goes round.

Captain Stopford: In harbour does the first engineer always come up when the Articles of War are read, after the captain has inspected the ship?

Lieutenant Hire: Yes; I have never known anything to the contrary.

Captain Stopford: Are all engineers in harbour, and those off duty at sea ordered to attend every muster and every punishment the other officers are?

Lieutenant Hire: Yes, excepting general quarters and evening quarters, and the second engineer reports the stokers.

Captain Stopford: Have you, since you have been on board the *Hecla,* ever had any reason to think that the engineers supposed that they were not governed by the same laws that all others on board were governed?

Lieutenant Hire: No, sir, none whatever.

Captain Williams: Was it necessary for prisoner to receive your formal permission before he got up the forge, for the purpose of doing necessary repairs to the engine?

Lieutenant Hire: Yes, it was generally done; in fact always.

Captain Williams: Did you ever refuse that permission?

Lieutenant Hire: Never decidedly, but I have said, on two or three occasions, it would be as well to get the forge up to-morrow or the next day, for some special reason, such as painting the ship, &c. and the prisoner has complied.

Captain Williams: Has the prisoner had access to printed instructions to inform himself of his duties and responsibilities?

Lieutenant Hire: They are supplied to them; I have seen them in their berths.

Captain Williams: By whom are they supplied?

Lieutenant Hire: They were supplied before I joined the ship; I cannot say by whom.

Captain Hardy: Are you aware if the forge was ever got up for the ship's use without being mentioned to the first engineer.

Lieutenant Hire: No.

This closed the prosecution against Mr. Johnson.

The assistant surgeon of the *Hecla* said the carpenter of the *Hecla,* one of the prisoner's witnesses, was confined to his bed with a severe rheumatic attack, and could not attend to-morrow.

The case for the prosecution terminated at 4 o'clock, when Mr. Johnson, having requested time to prepare for his defence, the Court adjourned till the following morning for that purpose.

At 8 o'clock the Court re-opened, when the prisoner having declared he was ready, the Judge-Advocate read his defence, which was to the following effect:—He begged to assure the Court that his motives for refusing to allow the forge to be sent on deck for the ship's use were good and innocent, as upon two occasions it had been injured, as would be proved; and as to the words which formed the charge of contempt, they were intended to eonvey his delight that the question would be set at rest as to whether the forge should leave his possession without a written order or not. He claimed the indulgence of the Court, and put in a certificate from the Commander of the *Wilberforce,* and a medal he had gained for good conduct.

The following witnesses were ealled in behalf of the prisoner:

Corporal Thomas Williams ealled and sworn: I remember the forge was on shore at Athens about 18 months ago; it was the first place I worked at; there was not mueh damage done to the forge; the forge was for the ship's use; it was damaged at Constantinople; it was damaged by overheating, and throwing water on it to put the fire out; it split the forge; this occurred 15 months ago.

Captain Glascock: Are you a blacksmith, and were you working at the forge?

Corporal Williams: Yes.

Captain Glascock: Were you working at the forge on the day it was split at Constantinople?

Corporal Williams; Yes.

Captain Glaseock; Did you put the fire out?

Corporal Williams: I cannot say if it was I or a man at work with me.

Captain Glascock: You knew water had been thrown over the forge?

Corporal Williams: Yes.

Captain Glascock: Who was at work with you?

Corporal Williams: Joseph Bishop, gunner, R.M.

Captain Stopford: Who had charge of the forge on shore?

Corporal Williams: I had.

Captain Glascock: Did you report it split when you went on board, and to whom?

Corporal Williams: Yes, sir, to Mr. Thompson, carpenter.

Captain Stopford: Did you ever work the forge at Constantinople after it was split?

Corporal Williams: Yes.

Captain Stopford: How many days did you work at it after it was split?

Cannot recollect Sir, I am a blacksmith by trade.

Captain Stopford: Was the forge fit to do the same ship's work as before?

Corporal Williams: No.
Captain Stopford: Do you know if it was sent to the dock-yard here to be repaired since it was split?
Corporal Williams: Yes.
Captain Williams: State to the best of your remembrance how many times you have worked at the forge between the periods of its having been split and 1st June last?
Corporal Williams: About a dozen times, I think.
Captain Williams: On those occasions did you ever hear that the prisoner had made any difficulty about allowing the forge to be got up for the ship's use?
Corporal Williams: No Sir.
Captain Williams: Did you ever hear that on those occasions he had asked for a written order before he could allow it to be got up?
Corporal Williams: No Sir, never before 1st June.
Captain Hardy: Are you aware of any cause which could have induced him to refuse to get forge up without a written order on 1st June?
Corporal Williams: Yes,
Captain Hardy: State it to Court.
Corporal Williams: On one occasion I was at work at the forge, Mr. Johnson sent me a vice, broken in the leg, and asked me if I would shut it for him; he said he was very busy and wanted it particularly. I had it in the fire to do it; the first lieutenant came to me and asked me who that belonged to, I told him to the prisoner, Mr. Johnson, the first lieutenant told me to take it out of the fire, and told me Mr. Johnson should not have it done until all his (first lieutenant's) work was done.
Captain Hardy: When did this take place?
Corporal Williams: Cannot recollect the date, I was at Constantinople; but about three months before 1st June.
Captain Hardy: Did you tell Mr. Johnson what first lieutenant said to you?
Corporal Williams; Yes.
Captain Hardy: What did prisoner say?
Corporal Williams: I cannot recollect that he made any remark to me, but he walked away; did not hear him make any remark to any one else.
Captain Williams: To the best of your remembrance was the forge got up between the period of the vice being taken out of the fire and 1st of June?
Corporal Williams: Yes, several times.
Captain Duffil sworn: Prisoner's general character and conduct was very good previous to the 1st of June, and I had every confidence in Mr. Johnson while in charge of the engines, I gave him entire charge of it.
Captain Williams: Had you any communication of any kind either personally or through the first lieutenant with prisoner between the 1st and 7th June, 1846?
Captain Duffil: Yes.
Captain Williams: State the full nature of that communication?
Captain Duffil: It was by letter, already forwarded to the Commander-in-Chief.
Captain Williams: Did you read the letter?
Captain Duffil: Yes.
Captain Williams: State to the Court to the best of your remembrance, its contents?
Captain Duffil: I do not recollect, I have a copy of it.
(Court cleared on the subject.)
Captain Glasscock: It has come out that you wrote a letter; consult with the Judge Advocate as to the propriety of producing it, the Court has not seen it, I do not wish its production. (Not produced.)
Captain Williams: Have you taken any particular steps that prisoner might be acquainted with printed instructions?
Question refused by Judge Advocate.
Lieutenant Hire re-called: What is prisoner's general character and conduct, I cannot but speak in the highest terms of all duty carried on between prisoner and myself, as first lieutenant. I always found him ready and willing at all times previous to the 1st of June to aid me in the performance of my duties.
Captain Hardy: Do you remember any thing of a vice being sent to be repaired, by Mr. Johnson, about three months previous to the 1st of June, when forge was up for ships' use?
Lieutenant Hire: I recollect Mr. Johnson coming to me and requesting the carpenter to be allowed to lend him a vice as one of his was broken and could not be repaired until we got to Malta, I gave my sanction to the request and it was sent down, I believe they had tried to repair the vice, but the heat of the forge was insufficient.
Captain Hardy: Do you recollect having refused to let that vice be repaired?
Lieutenant Hire: I do not, that is the only circumstance I recollect.
Captain Williams: Can you give any reason for an officer whose conduct previously had been so correct, all at once outraging every rule and regulation of the service?
Lieutenant Hire: No I cannot, I never was more surprised in my life when it occurred, more particularly from the good feeling I imagined to have reigned on all previous occasions of duty.

Captain Williams: Have you had any communication with the prisoner between the 1st of June and the order being issued for assembling the Court?
Lieutenant Hire: On one occasion I sent for prisoner on deck to ask his opinion on the subject of an engineer apprentice. On another occasion I sent for him and the other two prisoners telling them they were to go away to the *Ceylon*, they came to me again about their going, and about their savings, I had no other communication.
Captain Williams: On those occasions was any allusion made, either by the prisoner or yourself to the event of the 1st of June?
Lieutenant Hire: None whatever but what I have before stated.
Half-past nine o'clock: Court cleared.
Ten minutes to one o'clock: Court opened, when the witnesses names were called over and answered.
Captain Glasscock addressing prisoner said,
The Court have fully and finally considered your case, but will not promulgate their sentence until the trials of second and third engineers shall have been heard. Nothing however which may be elicited on their trial can affect you, your sentence is decided and cannot be altered.

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Tuesday.—David Douglas, was placed before the Court for disobedience of orders.
Lieutenant Hire: (still on his oath) stated by desire of Captain Duffil.
Mr. Douglas, prisoner, second engineer, was sent for, and appearing on the quarter deck, Captain Duffil ordered him to take charge of the engine and engine-room, he said he could not do it, he was not able. Captain Duffil repeated the orders three or four times. I asked him would it not be better to try, and he made the same reply. He said to Captain Duffil he could not try; he was not able, by his own words he (Douglas,) was not fit for an engineer. Captain Duffil repeated orders again, and then placed him under arrest. Nothing else took place.
Examined by Captain Glasscock: There was a likelihood of the *Hecla* going to sea at this time. Have never known the prisoner on other occasions take charge of engines when under steam.
Examined by Captain Stopford: The prisoner, in my opinion, is not fit by character, and the numerous cases of beastly intoxication, but I am not competent to judge of his powers mechanically, I should say the prisoner was able to work an engine, I have not seen him work one, but have reason to believe he has worked one. Three Engineers are allowed to *Hecla*. At sea they are disposed in watches according to their own arrangements; when the engine is stopped or backed, not more than one engineer, by order, must be in the Engine-room, nor more than one should be employed in blowing off or attending to height of water in boilers: the engineer on watch has complete charge of his engine, particularly at night. Have never heard complaints of prisoner's management of engines and boilers; was on board of *Hecla* before I joined her, about 20 months.
Examined by Captain Williams: During the 20 months that prisoner was second Engineer, he has to my belief got steam up, but cannot say when; have never had any part of machinery damaged at sea sufficient to stop a vessel; a steam pipe has required, on one occasion, to be shored up with deals to the beams, and on another after laying at anchor some weeks, the waste water pipe was choked. I do not remember any other derangement of engine, do not recollect seeing prisoner on either occasion employed in repairing damage; the engines have often been overhauled in harbour, and been repaired. Prisoner was always at his work, which seemed properly carried on: no complaints were made; had it been otherwise, it would have been reported to the captain; by properly carried on I mean to the satisfaction of first Engineer; have been five years a lieutenant. Had I been by any accident placed in charge of *Hecla*, I would not, in reference to his mechanical abilities, have objected to give prisoner charge; have complained to prisoner of his disobedience of my orders, when I have found him not sober, and he has told me he knew nothing about the wheels, have told him he was mutinous and a drunken beast, and from his blackguard conduct, he had on many occasions disgraced himself, and he was not fit for an engineer, and I would report him to the Captain.
By Captain Glascock: I reported him to the Captain. I do not know the result, but believe the Captain sent for first Engineer and asked his opinion. Captain ordered him to be sent away, as he was not dressed, and afterwards, on sending for him, he was not to be found for some time. He was afterwards found in the Sanctum, and brought up on quarter deck, Captain spoke to him and then walked away and spoke to me, saying he thought he was not sober, the first engineer thought the same.

Court cleared.

Commander Hardy Examined: Am aware of no cause why prisoner disobeyed the orders of his Commander to take charge of the engine, except that he had applied for his discharge from the service, and seemed in my opinion entitled to go any lengths: he made the application about a month or six weeks before the first of June.
By Commander Curry: Do not know of any answer having been received to prisoner's application.
By Captain Glascock. Do not know of any acknowledgment being made by Admiral: Captain Duffil transmitted it officially to the Admiral.

By Commander Curry: I never remember first Engineer unable to do his duty at sea from sickness; prisoner had not been on leave the night previous to the first of June.

By Prisoner: I sent for prisoner on the quarter-deck about turning the wheels, I did not give him orders myself, the mate of watch did I believe, I was not present at the time, but the mate of the watch had my orders to do so, he returned with a reply that he knew nothing about them. An examination took place before Captain Duffil, when there was no doubt the mate of watch gave the order.

By Captain Glascock: I directed Mr. Heather, Master's Assistant, to deliver the message about the wheels.

Lieutenant Jackson (Still on oath) deposed: I was officer of forenoon watch on 1st June last, and was present when prisoner was sent for by Captain Duffil to take charge of Engines, he declared "he could not" and "he was not able." The order was frequently repeated with the same result, except once he began to say, he had not been treated properly in the ship. Captain Duffill told him he could not listen to that, but asked him if he would take charge or not of the engines, to which he gave his former answer.

Examined by Captain Glascock: Prisoner never made complaint to my knowledge of what he considered, personally, improper treatment.

Examined by Captain Stopford: I have been 9 months in *Virago* before joining *Hecla*; have never been in a factory to study the steam engine.

Examined by Captain Williams: I know of some restrictions on prisoner's leave. When I was left, commanding officer Lieutenant Hire left orders that the prisoner was not to go on shore. I don't recollect any particular occasion besides, but I was under the impression his leave was stopped, and should have refused him if he left commanding officer at any other time time; had received no orders that his leave was stopped generally; Lieutenant Hire, when he told me not to allow prisoner to go on shore said, he was not in the *habit* of coming off drunk.

Court cleared on queston if 1st Lieutenant had the Captain's sanction to *stop a man's* leave.

I do not know if prisoner has a cabin in the *Hecla*. One boy served the three engineers, as I understood. Do not know how they messed, prisoner never worked extra hours, to my knowledge.

Examined by Commander Le Hardy: I know no cause to induce prisoner to disobey orders of his commanding officer, I know none but what he himself alleged to Captain Duffil (that he had been badly treated) to induce him to refuse taking the command of engines.

Mr. Telfer: Was on watch on 1st June on board the *Hecla*, when the prisoner was sent for on deck, I heard Captain Duffil order him to take charge of the Engine room, as he had put Mr. Johnson under arrest. He said I can't: the Captain repeated the order three or four times.

Examined by Captain Glascock: Have served 15 months in the *Hecla*, Do not know that prisoner ever complained of bad treatment by any superior officer; I had no reason to believe the prisoner discontented in his station.

Serjeant Hodges called: I was in the *Hecla* on 1st June last when the first Engineer was put under arrest. I heard orders given to prisoner to take charge of the Engines, to which he replied, 'I cannot, I am not able.' Captain Duffil said "you mean to say you will not," he replied, "no, Sir, I cannot." Captain Duffill said for what reason, he replied Lieutenant Hire has told me I am not fit to be a second Engineer, much less to take 1st Engineer's duty. I was then ordered to put him under arrest.

Examined by Captain Glascock: Prisoner was confined with 1st Engineer, in same cabin by day, but seperate at night. They have only one mess place, and mess together, 1st Engineer has a separate cabin, 2nd and 3rd have another cabin.

By Captain Curry; Lieutenant Hire said nothing in my hearing about the observation as to having been ill treated.

Mr. George Pinhay Heather, Master Assistant, *Hecla*, examined by Captain Glascock: I received orders from Lieutenant Hire, at Constantinople, about two months ago to get the paddle wheels turned by prisoner, I was in the gun room. Came on deck and saw prisoner with Mr. Wright walking on starboard side of quarter deck, I gave Lieutenant Hire's order, he replied he knew nothing about it, he had no order from Mr. Johnson; I asked Mr. Wright if he knew anything about it? he said "no," and I went down and reported to Mr. Hire, who came on deck and sent for Mr. Douglas. I did not hear their conversation.

Have served 23 months in the *Hecla*, prisoner did not serve in the *Hecla* all the time I was in her. He was in the ship, but went to the Hospital, prisoner has never made complaint of bad treatment he received from any superior officer in the *Hecla*. Never heard he was discontented with his station.

Captain Duffil examined by Captain Williams: During the time the prisoner was under my command, I had frequent and full opportunities of judging of his mechanical abilities, have commanded a steamer nearly 14 years, ever since 1832, I send to the Commander-in-Chief and Lords of the Admiralty a monthly report of the mechanical abilities of each engineer, As far as they related to prisoner, I considered him competent as a second Engineer, I considered his qualifications equal to those required by a part of printed instructions just read.

Examined by Captain Stopford: In my opinion, an engineer who has a ticket for second engineer, is, unless some extraordinary accident occurs, fit to take charge of an Engine.

Examined by Captain Glascock: Had an accident occurred to the first Engineer, incapacitating him from his duty, I should fearlessly and undoubtedly have entrusted the second Engineer with the charge of the engine room, from his knowledge of machinery, but for other reasons not; has been drunk on two occasions, and I should never be satisfied with a drunken Engineer for any length of time.

Examined by Captain Hardy: I cannot account for the conduct of prisoner on the present occasion, except he had applied for his diccharge and felt indifferent about it; the application for his discharge w through me to the Commander-in-Chief, he applied under the ple his leave having been stopped; the application has been acknowle by the Admiralty as having been received, I have heard nothing ther of it.

Prosecution against prisoner here closed.

Prisoner was allowed till following morning for his defence.

At eight o'clock on Tuesday, the Judge-Advocate read his defence, in substance as follows:—

He begged to assure the *Hon.* Court that at the moment he was called upon to take charge of the Engines, he felt himself justified in refusing, in consequence of his having failed in passing his examination as a second engineer, and therefore felt himself very unequal to the task. He entered the service as apprentice in 1837, and was now but an acting second Engineer.

He begged to declare that as deposed by Lieutenant Hire, he was not drunk when so stated to be.

He then prayed the mercy of the court, and begged them to take into their consideration the sufferings from confinement he had already undergone, and not visit his offence with severity.

He then read his warrant and three certificates, very much to his advantage, one from Commodore J. Washington, of the *Shearwater* in 1842; one from Commodore Postle, of the *Flamer* in 1844; and the last from Captain Duffil of the *Hecla* in 1845; when he was sent to the hospital. Prisoner called no witnesses, either for his defence or to character.

The Court here was cleared and re-opened in two hours, when prisoner was told his case was closed, but sentence would not be promulgated.

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Wednesday, Charles Wright, third engineer, was then placed before the Court for disobedience of orders.

Lieutenant Hire deposed as in the case of Mr. Douglas, that prisoner had orders to take charge of engines and engine room, when prisoner said "he could not," "he was not able," and Captain Duffil put him under arrest. Prisoner has taken charge of engines, under steam, during his watch.

Examined by Captain Glascock: Prisoner assigned no reason for his inability for taking charge.

Examined by Captain Stopford: Never heard any complaint made of prisoner's management of engines.

Examined by Captain Curry: When prisoner was ordered to take charge of the engines, I can't say if it was intended he should work them. When he said he was not able, I can't say what he meant, whether he was unable to take charge of, or work the engines, but I imagine he meant he was unable to take charge.

Examined by Captain Glascock: No officer asked the prisoner what he meant by his refusal.

Examined by Captain Williams: I think the prisoner *could* have taken entire charge of the engines night and day, if the *Hecla* had been at sea, but I think it hardly practicable, as it would have been very hard work.

(Here a question was asked by Captain Williams of witness, what was his opinion of the difference between *practicability* and *possibility*.)

By Commodore Le Hardy: I see no reason why prisoner could not have taken charge of the engines of the *Hecla*, I know no reason why he should have refused to obey the orders of his captain to take charge.

Lieutenant Jackson deposed in terms similar to those of the first lieutenant.

Mr. Telfer deposed as in the case of Douglas.

Ample proof of prisoner having often worked the engines was afforded by witness.

Color Serjeant Hodges deposed as in case of David Douglas, and adduced proofs of prisoner's capacity to take charge of the engines. On being asked what prisoner meant by incompetency, thought by his words "I am not competent" he meant if any thing particular should occur, he was not competent, cannot account for his conduct on the occasion. The Serjeant was complimented on the way he gave evidence.

Captain Duffil examined: In my monthly reports I stated prisoner to be competent as third engineer. Had first and second engineers by any accident been unable to perform their duties should have trusted the working of the engine to prisoner. Never had any complaint from first engineer of prisoner's incompetency to take charge of engines or work them when under steam. Had the *Hecla* been deprived of the services of three engineers and the services of the *Hecla* been required, I would have got under weigh by two engineer apprentices and leading stoker, Edward Peatling, who has worked an engine, and was willing to do so.

Examined by Captain Stopford: I had every confidence in the prisoner's mechanical abilities.

The evidence for the prosecution closed soon after noon, and a little before two the prisoner's defence being ready, the Court re-opened, and in substance the Judge Advocate read his defence as follows:—

Prisoner observed that his motives for refusing to take charge were his inability to assume the onerous duties and responsibilities required, but had he thought he should have been required only to do the best he could, he could not have hesitated.

He deeply regretted the circumstance, and hoped the Court would mercifully take into their consideration that he had been three months under arrest.

Certificates highly creditable were read from Lieutenant W. N. Hasty, of the *Megæra*, when he was engineer-boy, from Captain Bullock, of the *Tartarus*, and Captain Duffil, of the *Hecla*, as third engineer.

Mr. Wright called the following witnesses in his defence.

Captain Duffil called: I have no reason but to be fully satisfied at the manner the prisoner carried on his duty and conducted himself, do not know *one* cause of complaint to make against him, *not one.*

Lieutenant Hire called: I always found prisoner zealous and attentive to his duties, his conduct was steady and correct as far as was under my notice as first lieutenant.

The proceedings being closed, the Court was cleared, and at 4 o'clock re-opened, when the sentences were read by the Judge Advocate.

*Sentences.*—William Johnson to be discharged from H.M. Steamer *Hecla*, to be mulct of all pay and allowances due to this date, and to be reduced to the rank of second engineer for the term of twelve months, with a recommendation that at the expiration of the time, he be re-instated in his former rank, provided that his conduct merited the approbation of his superiors.

David Douglas was liberated in consequence of a flaw in the charge preferred.

Charles Wright was mulct of all pay and allowances due to him, and sentenced to continue in his present rank without being able to be raised to a higher one, for the term of one year.

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## Art. II.—EXPERIMENTS ON THE STRENGTHS OF DIFFERENT KINDS OF TIMBER USED IN SHIPBUILDING, WITH REMARKS UPON IRON SHIPS.

We are favoured this month with the results of some carefully conducted experiments made by Mr. William Steele, of the firm of Robert Steele and Co., Shipbuilders, Greenock, to ascertain the comparative strength of different kinds of timber used in the construction of ships. The experiments we consider very valuable, as exhibiting a fair and faithful comparison of the strength—not of choice selected specimens of the several woods from large lots—but of pieces of the average quality used in practice in the construction of ships.

The experiments were made as follows:—Pieces of timber, measuring each 14 inches in length, $\frac{3}{4}$ of an inch in breadth, and $\frac{1}{2}$ an inch in depth, were severally suspended at the ends, and loaded on the middle. The loads were slowly and carefully increased by small amounts, and at intervals of time sufficient to allow of the timber having the full effect of one weight before the following increase was made, thus avoiding the possibility of the timber being broken by a succession of shocks, and ensuring the tension of the fibres of the wood through its whole depth. The beams were laid on their flat, that is, the depth was $\frac{1}{2}$ an inch, and breadth $\frac{3}{4}$ of an inch, and the following is a table of the weights which, laid or suspended at the middle, broke the several kinds of woods:

| | | |
|---|---|---|
| Green Heart | = | 254 lbs. |
| Locust | = | 198 |
| African Oak | = | 181 |
| British Oak | = | 168 |
| Quebec Elm | = | 150 |
| Quebec Oak | = | 130 |
| Moulmein Teak | = | 91 |

The above experiments have additional value conferred on them by the fact that they have been made by a gentleman on whose accuracy of observation we can fully depend, and who, being himself a practical shipwright, is a competent judge of what constitutes a fair mercantile specimen of each timber, a qualification of high importance, and to be met with but seldom amongst persons who direct their attention to investigations of this description. The table of results with which we have been favoured is limited, and we recommend Mr. Steele to extend his experiments, which we shall have much pleasure in recording.

We had lately an opportunity of examining two large steamers at present building in Greenock by Messrs. Robert Steele and Co., for Cunard's line of packets between Liverpool and Halifax. These steamers are the largest that have yet been built for that Company, or indeed for any other, being, we think, with the exception of (if, indeed, these are so,) one or two in Her Majesty's service, the largest steam ships ever built, and they are truly a magnificent specimen of marine architecture. The models of these ships, which were designed by Mr. William Steele, are, in symmetry and shape, everything that refined taste and mature judgment could suggest, and in strength they are equal to any wooden steamers we have yet inspected. These steamers measure,

| | | | |
|---|---|---|---|
| Length of keel and fore-rake | = | 250 feet. | |
| Breadth of beam | = | 38 | 3 ins. |
| Depth of hold | = | 25 | 9 |
| Builder's measurement | = | 1767 tons, O. M. | |

The floor all fore and aft is solid, and the floors measure 16 inches square; the paddle-beams, which are of Green Heart, measure 26 inches moulded, by 22 inches sided, being each in two lengths, and each length in four pieces securely bolted together, an arrangement of which we think highly for the formation of a large paddle-beam; being superior, in our apprehension, to one piece of timber, which, from the enormous size necessary would unavoidably be faulty in several respects. We examined these steamers very carefully, and admired in their construction the very complete and effectual system of iron trussing adopted for the sides.

But while we admired in all respects the beautiful and substantial vessels building by Messrs. Robert Steele and Co., we were unable to extend the sentiment to the judgment evinced by the Directors of the Steam Navigation Company, who could overlook the advantages offered by iron in the construction of steamers for such a service as that of the Halifax line. Iron steamers are fast gaining the ascendancy over those of wood for most purposes of intercommunication; and if there be one service for which they are better adapted than another, it is the very service for which these Halifax packets are designed.

The principal advantages possessed by iron ships over those of timber are, greater strength than it is possible to attain by any known combination of timber, less weight, greater available capacity inside with the same external dimensions, greater speed—from diminished immersion, less cost of maintenance, and consequently less time lost for necessary repairs.

These are the principal advantages that occur to us at the moment, but the collateral advantages are very numerous, and against them all is to be placed the supposed liability of the iron ship to oxidation and corrosion; but, whatever may be the extent of that ozidation and corrosion after lengthened periods, it is well understood that if the ship's bottom is kept well coated with a proper composition, no such thing as corrosion takes place, and the Halifax service admits of surveys and repainting abundantly often to maintain the ship's bottom in complete order. Whatever may be the result of sending iron ships to the seas on which those of the Peninsular and Oriental Steam Navigation Company are to trade, and whatever opinion may be entertained of the propriety of introducing iron ships so extensively into that Company's fleet, at which, nevertheless, we feel no alarm, it is at least certain that for the service of Halifax Company, iron ships, which possess advantages so numerous and so unquestioned in the case of navigation in the temperate zones, are greatly preferable to ships of timber. The most formidable dangers to which the vessels upon the Halifax line are subject, are fire and collision with icebergs; and it is only by the use of iron vessels that the alarm incidental to the existence of such dangers is to be dissipated, or that real security can be conferred. Water-tight bulkheads, which offer so great a security against foundering, have as yet only been successfully applied in iron vessels, and iron vessels are manifestly the only kind that can approach to the quality of fire-proof. The adhesion of barnacles upon the bottom of an iron vessel traversing the waters lying between the United Kingdom and Halifax need not be much apprehended, but an effectual remedy against such an inconvenience is to be found in the soluble poisonous paint, the method of preparing which we explained in a previous number.

Iron ships have now been used for many years on the Glasgow and Liverpool station with the most satisfactory results; and a sufficient proof of the high estimation in which they are held is afforded by the fact, that whereas one of the opposing companies, whose vessels are of timber, was in the habit of stating in their advertisements, as an inducement for passengers to go in their ships, "that their ships are of timber," the same company is now introducing an iron steamer as the only means of successfully coping with the iron vessels.

After all, however, there is some vexation in the reflection that timber shipbuilding, which has now arrived at such perfection, as is exemplified in the ships at present building by Messrs. Steele and Co., should be doomed to speedy relinquishment; but it is very evident that a shipwright best consults his own interest by at once directing his attention to the removal of any objections yet attaching to iron ships, rather than by attempting to perpetuate the use of wooden ones—an attempt that can only issue in defeat. We fully expect that when our young friend Mr. William

Steele directs his attention to iron shipbuilding, he will manifest the same skill in that branch of art that he has already displayed in timber shipbuilding, and we expect soon to find him reaping new honours in this great but undeveloped field.

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## Art. III.—THE LOGIC OF RAILWAY DIRECTORIES.

Cato in some of his late letters to the *Times*, gives us a specimen of the logic of these oligarchies, the accuracy of which every one coming into communication with them, must confirm. He says:—The insolence of the railway people, when the extravagance of their fares is alluded, is quite amusing. "What right have you to complain?" they exclaim. "It is true we charge you twice or thrice the fares exacted in other countries, but you paid more for coaches before we enabled you to travel by railway, and do we not both accelerate your journey and carry for you an amount of luggage which formerly you must have sent by the waggon? What right have you to complain of our fares when we have put you in possession of so many advantages? If you dislike our railway, betake yourselves to your turnpike roads, and start coaches on them, in God's name, but do not bother us."— Are you then, we would ask, O Railway Potentates, to have the monopoly of the benefit of this new invention? Your argument assumes such a right and where and how did you acquire it? It is true that railway travelling is better and cheaper than coach travelling, as calico is better and cheaper than it was in the days of Elizabeth; but is this any answer to the allegation, that our locomotion is neither as good nor as cheap as it is in other countries, or as it would be here but for your exacting domination? Why should the English public be worse off in the single article of locomotion than the public of France or Germany? Why should a monopoly be interposed between the artizan and this new invention to defraud him of its fruits? Would it be any justification of any monopoly of calico or broad cloth by which the English public was made to pay three times as much as other nations, that three centuries ago those articles were still dearer? What railway monopolist would be reconciled to the payment of twice or three times the proper price of those articles on such a plea? And if we have the benefits arising from improvements in the production of calico, why should we be defrauded of the benefits of improvements in locomotion? You say indeed, O Railway Potentates, that in the construction of a railway you made a great experiment, from the success of which you ought to derive a benefit corresponding to the loss you would have sustained had the experiment been unsuccessful. But the only experiment you made in preferring the security of the North Western to that of Mexico, was a *commercial* experiment, such as is made by every man who builds a mill, or digs a dock, or starts a newspaper, or invests money at all; and it is not out of *such* experiments that any lien upon the public purse is to be extracted. Had railways indeed been the invention of any one man instead of growing up insensible out of co-existing circumstances, that person would certainly have had a valid claim upon the public liberality. But such a claim could not have extended to those who only adopted his invention after its efficacy had been fully demonstrated, and this is the extent of the achievements of the railway kings. We have seen no defence of the existing railway system, which any unbiassed man of common sagacity would not characterise as weak and disengenuous. Like every other abuse, it of course has its defenders, who fatten on the public plunder; but the logic of such literary mercenaries is usually as weak as their virtue.

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## Art. IV.—THE WELLINGTON ARCH STATUE.

What now shall we say of the Wellington statue? The unheard-of barbarity of placing the statue on the arch has been perpetrated, and the public, instead of being horrified by the apparition, only wonder how so great an outcry could have been raised against so becoming a combination. The *Times* has read its recantatation, and after all its severe philippics, declares that the arch and statue seem to suit one another very well, and that it would be unwise to disturb a union which is justified by the public assent, and so much exceeds the public expectation. It is assuredly the fact, that public opinion is in favour of the continuance of the statue on the arch, and ratifies the sentence we passed some months ago upon the intended alliance; but Lord Morpeth, it appears, has referred the question to some "competent persons," to which description Royal Academicians are supposed to answer, and their opinion being adverse, it is said that the statue is to be removed again from its present situation. The public voice will not, however, recognise the authority of these "competent persons" as any justification of such a step, and indeed it appears to us that Lord Morpeth's "competent persons" are the very worst by whom the question at issue could be decided. Architects and artists are so much fettered by precedent that they condemn everything which looks like an innovation, and the question with them is not whether a certain arrangement is intrinsically judicious, but whether it can be justified by a reference to Vitruvius or the Parthenon. It is these same "competent persons," as the *Times* shrewdly observes, who have built the National Gallery, Buckingham Palace, the Trafalgar Fountains, and all the other monstrosities that London boasts; and is it the decision of *such* "competent persons" that we are to recive as an oracle? At first the cry raised by the "competent persons" was, that the statue was too large for the arch. Now it is that in consequence of the size of the arch the statue loses its formidable dimensions. Within the last week too, they have discovered that it is a monstrous violation of taste that a rider with a military cloak, should be associated with an arch which has Corinthian columns. But wherein is the arch worse in this respect than the Nelson Column, which is of the Corinthian order, yet is surmounted by a man in a cocked hat and naval uniform, or than the Duke of York's column, or than the Monument, on which, though of a classic order, Charles the Second is sculptured in a periwig, dealing out consolation to the poor of London, while sundry angels float in the clouds to applaud the deed. A people can afford to dispense with a classical congruity who build Parthenons with plate-glass windows for railway stations, or take for the seal and centre of a classic gate the Royal arms, with all their heraldic mysteries, as is done in the case of the gate of this very Wellington gateway. Why should we strain at such gnats when there are so many camels to swallow? It is sufficient for us to know that the statue is not too large for the arch, as was at first asserted, but that the two objects seem to answer one another very well. The arch certainly wanted some such piece of sculpture to make it complete, and the statue wanted a commanding situation, such as the arch affords. We have always held that the public, in any such matters, are better judges than the generation of artists, inasmuch as the technical associations of the multitude redress one another; and the public is certainly content that the statue should remain where it is.

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## Art. V.—ROUEN AND HAVRE RAILWAY.

### Mr. Locke's Report.

Gentlemen.—I have the honour of laying before you, in the most concise form, an exact account of the state of the works, so as to enable you to judge of the period of their entire completion. On leaving Rouen, the earthwork which conducts to the river has experienced a considerable settlement, and it will take several days to establish its permanent junction with the bridge. This bridge is terminated, and only waits for the trial proposed by the Council-General of the Ponts-et-Chaussées. The tunnels of the passage through Rouen are entirely finished, the definitive way is laid down, and nothing more is required to render the Rouen station fit for working than a little ballast, and some switches, crossings and turn-tables. It is now about a month since the works of embankment have been terminated along the entire line, and the definitive way laid down; but the heavy rains which have fallen during that period, have produced some considerable sinkings down onseveral points of the vegetable earth of the slopes. This circumstance has modified the appearance of finish which the line presented a month back; and, in addition, the completed way is in a less satisfactory state in consequence of these sinkings. This remark applies to the whole line, and it will be necessary to raise the earthwork, to add to the ballast, and to re-adjust the rails, before the railway can be opened to the public. This operation will occupy about two or three weeks. The effect of the late rains on the works has all at once produced that consolidation which otherwise could not have been effected in a much longer time; and it is satisfactory to learn, that with the exception of a side-wall of a small bridge near St. Laurent, the mason-work has not experienced the slightest damage —that all the bridges constructed under the line have resisted this rapid consolidation of the embankments. This trial is far more severe than is usually applied to constructions of this nature. The two small viaducts of the valley of Harfleur, which were slightly affected by the pressure of earthwork that joined them, have been repaired. The engineers of the Ponts-et-Chaussées have proposed to make trial of these works by a weight to which I make no objection. The other bridges on the line, which have been already loaded, have sustained the test without any deterioration. The viaduct of Malaunay, which for nearly six weeks has been sustaining a weight of about 2,000 tons—a load four times more considerable than any that in the usual course of working the line can be brought on this construction—has undergone no alteration whatever. The Council-General of the Ponts-et-Chaussées has demanded a still greater weight. You have at my suggestion confirmed by the opinion of many eminent engineers unconnected with your undertaking, proposed a modification, which, if accepted, will afford every guarantee for public safety, without impairing the solidity of the viaduct. The existence of the weight on the viaduct has, by intercepting the communication, prevented, and will still prevent the transportation of the sand intended for the ballast prescribed by the Council-General of the Ponts-et-Chaussées for the viaduct of Barentin, and which we cannot obtain except from Sotteville, beyond this point of junction with the Rouen line. The accident of the viaduct of Barentin, on which I have already sent you in a special Report, has been repaired. All the arches are finished, workmen are now employed on the parapets and in laying down the way, and as a locomotive has passed lately over the viaduct, there is not any reason to doubt that in a fortnight or three weeks this work will be completed. The viaduct of Mirville is in a similar state of advancement, and nothing remains but to place the parapets and the way. The stations, without being finished, are generally in a very forward state. The Rouen station still requires some works of detail, although the approaches and the exterior of the building are terminated. At Barentin, Parilly, Yvetot, Alvimaire, St. Romain and Havre, the offices are finished, and those of Maromes, Malamay, and Nointot are in progress. The committee of inquiry for the station at Beuzeville have not yet assembled, and we await their decision. The switches, crossings, pumps, pipes and reservoirs, are in a state of advancement. The station for travellers at Havre only waits for its internal fitting up, and that for goods is in progress. It is the same with respect to the workshops and the coke furnaces. The houses for the guards of passages on the level are all built, and the works at the station can permit the line to be opened in the course of next month. It results from these details that the works are very nearly terminated, and that the stations and the arrangement of the way may occupy two or three weeks before being fit for the service of the public, that time being about what is necessary to go through the proofs described by the Council-General of the Ponts-et-Chaussees. The delivery of the stock is not so forward as the stocks on the line and the stations, but notwithstanding, by means of the quantity that is about to be delivered, and through the assistance of the Rouen Company, the opening of the line can take place in six weeks from the present time.

JOSEPH LOCKE.

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## ART. VI.—INDIAN RAILWAYS.

The momentous subject of Indian Railways is at present attracting much attention both in India and in this country; and public expectation is raised to a high pitch by the anticipated introduction of this new system of locomotion into so magnificent a field. Of all countries in the world India is probably the one in which the railway system may be expected to work out the grandest results, for in none are the existing means of internal communication more defective, and in none is there such an accumulation of the materials of wealth, which need only the attainment of facility of transport to bring them into profitable combination. With a density of population in the lower provinces exceeding that of any country in Europe, profound tranquility, an industrious people, and a soil which yields in rich abundance, the most precious productions of a tropical climate, there co-exists such a difficulty of locomotion as to turn these high distinctions into barrenness, and to reduce commerce to the lowest ebb. The cotton of Nagpoor and Amrowty which is brought for sale to Mirzapore, a distance of 500 miles, is transported the greater part of the distance upon oxen, which carry 160 lbs. each, and travel, on the average, 7 miles a day. The cost of conveying 160 lbs. 100 miles in this manner, is about 5*s*., and should rain occur during the interval, the cotton is saturated with wet, and becomes too heavy for the oxen to carry; the men and cattle sink in the soft earth of the unmetalled tracks which stand in the place of roads, and both merchant and carrier are ruined. The general character of the roads throughout the country is of this impracticable description, and products yielded by the soil in rich luxuriance, and for which, if facility of transport existed, a profitable market could readily be found, are suffered to go to waste and lie neglected. The same impediments too which prevent the products of Central India from reaching our shores prevent our productions from being carried thither; and the formation of Indian railways must, as a collateral benefit, add largely to the consumption of British manufactures by opening up districts that are at present inaccessible to them. But these views are poor and feeble. If it be a benefit to give a security to our Indian empire, such as it could never otherwise acquire—endowing it as in the living anatomy with electric nerves to telegraph every throb throughout the system to the governing head and enable military force to be concentrated upon any point with inconceivable rapidity and overwhelming effect—if it be a beneficent act to awaken to a new existence 150 millions of people, on whom the sleep of ages has fallen, by overturning their conceptions of time and space, unfettering their energies, and rousing them to exertion by new incentives—if it be a benefit to draw European settlers into India who will expend capital on land the railways will make productive, thus furnishing an example to the native population, and leading onward to that course of subsidiary improvement which facility of intercourse will create—then are Indian railways a benefit, and every moment they remain unestablished occasions a loss of wealth and happiness, of which it would be hard to exaggerate the amount. As a commercial enterprize, the more important of the Indian railways present attractions such as are rarely surpassed, and which we propose to examine in some detail, but even on the supposition that those railways did not return their expenses, and that the deficiency had to be made up by the Indian Government, their formation would nevertheless be expedient; as a greater gain would be realized by the diminution of the army that the railways would render possible, the superior health of the troops, and the greater ability on the part of the people to bear taxation, than any loss the working of the railway could occasion. Fortunately there is little need of dealing with any such hypothetical case, as there is very little doubt that whatever railways in India are likely to be made, will return a large profit. But if it would have been a benefit to work Indian railways even at a loss, what must the benefit be when they enrich all concerned?

There are three lines of railway at present projected in India which divide the suffrages of the public. The first runs from Calcutta in the general direction of the Ganges, through Mirzapore and Allahabad, on to Delhi, and it is intended eventually to continue this line to Ferozepore, upon the Sutlej, the scene of the late conflicts with the Sihks: the second extends from Calcutta to a town on the Ganges, 180 miles distant called Rajmahal: and the third runs from Bombay to Alleh, with extensions to Mhuse and the Pera River, and branches to Sholapoor, Hyderabad, and Indore. The two last are chiefly to be regarded as commercial projects, but the first in addition to its commercial merits, puts forth the claim of being a great political engine, by which the North West Frontier, which is the most vulnerable part of India, may be secured against future irruptions. Had this railway been constructed at the time of the late wars with the Sikhs, a prodigious waste of life and money would have been averted: troops that were 3 months in reaching their destination, and which arrived at the end of that time worn with sickness and fatigue, could have been transported through the same distance if a railway had been available, in 3 days, and with unimpaired health and vigour. The resources of Fort William moreover, which is the chief magazine in India for military stores, as well as those of Allahabad, Cawnpore, Agra and Delhi, would all have been made available for the immediate uses of the army, and a force could have been thrown at any moment on any point of the frontier, in such a strength as to overwhelm the enemy and disconcert all his operations. And not only is railway transport the most rapid and effectual for such a purpose, but it is by far the cheapest, even if we do not reckon the saving of time or health it achieves;—the cost of transporting troops by railway being actually less than when they go on foot. Nor is there any danger of this powerful adjunct of military operations being wrested from us and turned against ourselves, for railways are altogether instruments of defence, and, even though taken possession of by an enemy, they could render him but little assistance. In all probability he would be without carriages or locomotives, and even if he possessed them, the removal of a few rails from the line at intervals, or the demolition of a few of the viaducts, would render the railways useless to an invader. The services rendered by a railway in enabling a small standing army to quell wide-spread insurrection were experienced in this country in 1842, and in India these benefits would be still more extended and conspicuous. They give ubiquity to the ruling power, and concentrate the strength of the empire into a focus—thus turning doubt into security, and making small means great.

The political fruits of the line leading from Calcutta to the North West Frontier are of so important a nature that the Indian government may naturally be supposed to be impatient for its formation. Its commercial prospects, however, are equally alluring, and it may be doubted whether they do not transcend those of any other railway in any other country. Mirzapore, one of the points through which this line passes, is the great mart for the productions of Central India, while the value of the exports and imports of Calcutta is about 17,000,000*l*. a-year, of which, probably, the greater part passes in the direction the proposed railway will follow. Above Mirzapore, again, on the road between Allahabad and Cawnpore, an immense traffic exists, the amount of which is given in Mr. Macdonald Stephenson's report upon Indian Railways, from which we gave some citations in a former number; and on the road leading to Burdwan, which is about 80 miles from Calcutta by the track the railway would follow, there is a very great trade in salt, coal, which is mined there, goor, and other articles of large consumption. Mirzapore is about 450 miles from Calcutta, and the journey thither and back by Dawk occupies at the least 10 days, and involves an expense of 60*l*. By the steam vessels on the Ganges, which proceed from Calcutta to Mirzapore, the expense is not less, and the time occupied is four times greater, while the length of the journey by railway would not exceed 15 or 16 hours. Goods are transported by land from Mirzapore to Calcutta only with great difficulty and at immense expense: much merchandize is lost or damaged in crossing the rivers, especially the Saone, a large river which runs into the Ganges, and which presents many engineering difficulties to the construction of a bridge. The rate of freight charged by the steamers on the Ganges between Mirzapore and Calcutta is about 2*l*. 10*s*. per ton; the speed does not exceed 50 miles a day, and as the vessels have to stop by night, the voyage is very tedious. The ledges and shallows in the Ganges above Allahabad prevent the steamers from proceeding further up, and the sharp rocks in the bed of the Jumna present a barrier in that river equally insurmountable. The navigation of the lower part of the Ganges, again, is beset with serious difficulties. The head of the Delta is situated at Rajmahal, about 180 miles north of Calcutta, and at this point the Bhaugirruttee and Jellinghi branches break off from the main stream, and uniting their waters at Nuddeya constitute the Hooghly, which flows past Calcutta into the Bay of Bengal. The navigation of these offshoot streams is always difficult, and during a considerable part of the year impossible, and the steamers are compelled to make a circuit through the perilous labyrinth sof the Sunderbunds, and to pass through a distance of 528 miles to reach a place only 180 miles distant. These impediments to the navigation of the Ganges constitute a limit to the competition that river can offer to a railway, as well as a reason for the formation of one; and although the navigation of the Ganges would no doubt be improved, yet the amelioration would involve a large expenditure, and it does not appear probable, from the examinations which have been made, that the improvement could be extended to the Bhaugirruttee channel, which, even if deepened and opened up, would soon become choked again with alluvial deposit. Besides, there is no measure of improvement the navigation of the Ganges could receive, that is capable of realizing for the country the political and social benefits the institution of the proposed railway would secure, and the necessity for its formation, therefore, any such improvements even if accomplished could not supersede.

We have already mentioned that one of the Indian railway projects is the formation of a line between Rajmahal and Calcutta; and in Calcutta this line is, we believe, popular, especially among the persons interested in the success of the steamers on the Ganges. The author of a small work upon Indian railways, who writes under the patronymic of "An Old Indian Postmaster," displays much zeal in the advocacy of this project, on the ground that the navigable part of the Ganges affords sufficient locomotive facilities to the regions through which it passes, and that it is more judicious by tacking railways to the ends of this navigable portion, extending from Rajmahal to Delhi, to supplement the defects of the Ganges, than to construct a railway with which the Ganges must compete. It reveals, however, we fear, a rather Indian conception of what constitutes sufficient locomotive facilities for a great country when those facilities are supposed to be afforded by a speed of 50 miles a day, or about two miles an hour; and we hardly think the achievement of such a result will, in the estimation of unbiassed persons, be regarded as superseding the necessity for Indian railways, or that railways need apprehend the consequences of such a competition. No doubt the Ganges, even if a railway is opened from Calcutta to Delhi, will still be used for the purposes of internal transport; many heavy articles, for which speed is no great consideration, instead of being carried by the railway, will be carried by the river. But it appears very doubtful to us whether those articles, or, indeed, *any* of the articles then transported by the river, would be unladen at Rajmahal, even if a railway were conducted thither; and we humbly conceive that, so far as the Ganges trade is concerned, it would be much more benefitted by the formation of the Rajmahal canal projected by Col. Forbes, on such a scale of magnitude as to enable the vessels navigating the Ganges to pass through it without the necessity of transhipment, than by any railway whatever. A railway from Rajmahal can never become a substitute for a railway to to the North West Frontier, and we have yet to learn what effect the formation of the latter line will produce upon the trade of the Ganges as it bears upon a railway to Rajmahal. Will not the railway to Delhi and the North West Frontier, or, as we believe it is called, the East India Railway, take from the vessels on the Ganges the great bulk of the passengers, and the finest articles of merchandize, for which alone speed is of importance? And if nothing is left for the Ganges trade but coarse and heavy cargo which does not require speed, is it likely that such cargo would be unloaded at Rajmahal, subject to all the expense and risk by transhipment and loss by peculation, to be conveyed from thence to Calcutta by railway?

The distance of Mirzapore from Calcutta we have already stated as 448 miles. Delhi is 452 miles from Mirzapore, and the North West Frontier is about 260 miles from Delhi. Taking the distance Rajmahal from Calcutta at 180 miles, though 200 miles would probably be a nearer approximation, it appears that by adopting the route by Rajmahal to the North West provinces, and taking the Ganges between Rajmahal and Allahabad, as the Old Indian Postmaster suggests, as part of the connecting chain, we save only about one-third of the length of railway in proceeding to the North West Frontier, while for the sake of saving this third we increase the distance and extend the time so much, that a good mail coach running on a turnpike road, would be more expeditious than such an amphibious communication. It is clear. therefore, that even if the commercial aspect of the question be alone regarded, it is impossible the Indian government can adopt the 'Old Indian Postmaster's suggestion of making the Rajmahal the initiatory line. It is very doubtful whether the formation of that line *at all* is expedient, and what magic is there in the Rajmahal line to compensate the government for the loss of all those political benefits the postponement of the East India line would occasion? How could an army be precipitated upon the frontier with a rapidity to confound all machinations, if the patchwork line of the 'Old Indian Postmaster' with all its drags and complications were to be the only dependence. If an army were to be brought to Rajmahal how could it be sent forward? It is clear the steamers on the Ganges could not convey such a multitude, and what would be the time occupied if they were carried only in successive voyages? It is a question whether with *such* means of acceleration time would not be saved by marching by the road, and the result would be, if the Old Indian Postmaster's plan were adopted, that after the loss of much valuable time in a vain experiment, the benefits due to railways would remain unrealized until a continuous line was constructed—which moreover might render valueless the line first made. The establishment of the electric telegraph, which we understand the East India Railway company proposes to carry to the frontier, appears tobe scarcely possible except upon a direct line, and such an instrument appears to us calculated to render important services to the government, by binding remote parts of the empire into close proximity. It is at present contemplated, we believe, to complete only parts of the East India line—one portion leading from Calcutta to Burdwan, and another portion through the Doab between Allahabad and Cawnpore. But we think the Indian government should require the railway company to open up the whole line to Delhi without delay, as there is a serious loss in any postponement of such a measure if the benefits are as great as are asserted. The political ends of the line cannot be compassed unless it be unbroken; and in the present unsettled aspect of affairs in Lahore, it would be most unwise, we conceive, for the government to shut out the aids an unbroken railway communication could afford.

It is unnecessary to dwell upon the physical features of the proposed East India Railway, as they are fully set forth in the report of Mr. Simms and his coadjutors, which we published in a late number. The district through which the railway runs is upon the whole wonderfully free from engineering difficulties of every kind, the only one of any prominency being the bridging of the Soane, a large river flowing over a bed of sand; but even here the question is one only of expense. The ravages committed by the white ants in India upon ordinary timber involves the necessity of using some preparative process such as Kyan's; and it is found that when timber is thoroughly impregnated with such a preparation by hydrostatic pressure, or by introducing the preservative liquid into the live tree, it may thenceforth be reckoned safe against the ravages of the white ants as well as against the dry rot. It is doubtful, indeed, whether the white ants would attack timber subject to such violent vibrations or concussions as railway sleepers have to withstand; but nothing should be risked in a matter of such importance; and unless stone blocks be employed. or sleepers of Moulmein iron-wood, or cast-iron attachments, such as are used on some of the American lines, sleepers that have been prepared by some effectual curative process should be adopted throughout the line. This last alternative is the one of which we most approve, inasmuch as timber has been found preferable to stone for railway foundations, and the preparation of wood by Kyanizing or some equivalent process is the method of which we have most experienced for securing it against dry rot or the ravages of insects. No doubt this preparation of the timber will add to the expense; but on many of the English lines this method of preparing the timber is adopted, and it does not appear probable that the cost of the line between Calcutta and Delhi, though formed with a double line of rails and constructed in the most substantial manner, will exceed 13,000*l*. a mile. It is false economy in the case of a grea ttrunk line, such as the East India Railway, to be content with any but the most complete aud substautial modest of construction. The gradients too should be good, and the line direct, without turning to the right or left to pass through neighbouring towns which may be adequately accommodated by branches; for in all human probability this line will not stop at the frontier, but will pass on into Persia, and perhaps eventually iuto Turkey, until it at length reaches Constantinople; and then we shall be able to pass from London to Calcutta in little more than a week. We know that to most persons this will appear a very visionary expectation, but in everything relating to the achievements of steam, the visionary people have been far oftener right than those who plume themselves upon their practical sagacity. It was *visionary* not twenty years ago, to talk of a speed exceeding ten miles an hour on a railway; it was *visionary* to cross the Atlantic by steam; it was *visionary* to maintain a regular steam communication with India by the way of the Red Sea and the Egyptian desert; it was *visionary* to connect Ostend by railway with Constantinople; and until the other day it was *visionary* to project a railway from Calcutta to Delhi. Every great step in the world's progress has at the first been visionary; but the rapidity with which steam works its inchantments, confounds the arithmetic of practical stolidity. Practical men, it appears, have yet to learn, that in such anticipations 'to doubt is to rebel,' and that in dissolving the question of human progress rashness lies in scepticism rather than in faith.

We fear these remarks have drawn out to too great a length to enable us to say much respecting the third scheme to which we have referred, which has its terminus at Bombay, and of which the Great Indian Peninsula Company are the promoters. Nor are we sure that any discussion of its merits would not be premature, as we scarcely think it probable that the Indian government, after having secured to itself the benefits of the political line, will until after it has been tested, offer sufficient encouragement to any other railway to induce its construction. Such a delay is nevertheless to be regretted, especially as, if Bombay were to be connected with Calcutta by railway, the length of the voyage to England would be considerably abridged. As regards the Bengal lines the political grounds will necessarily determine the decision of the Government to adopt the trunk line at once, and if they can profit by the experience of the past they will place all the branches under one company's management.

We have considerable doubts, moreover, whether there is any benefit to be derived, and, indeed, whether there is not a very material detriment in distributing the construction of Indian railways among different companies who may have conflicting interests, and among whom it may be difficult to preserve the concord necessary for the public service. In England the inconveniences of the system have been found to be so great, that the different companies have spontaneously proceeded to redress them by amalgamation, and wherefore should a system be introduced into India that has in England well nigh wrought its own extirpation? If amalgamatioe be beneficial, it would surely have been more beneficial if there had been no separation; economy is promoted by one management, strength consolidated, and uuanimity secured; and we therefore do think that it behoves the Indian Government, in introducing railways into India, to deal only with one party, from which conditions more favourable to the public service might then be exacted. Against this there would of course be the outcry of monopoly, but there would be no reason in such a cry; for, so long as the lines do not compete with one another, there is no more monopoly in the possession of the lines by one company than in their possession by any number. The monopoly of the London and Birmingham Railway Company is not diminished by the formation, by a different company, of a railway from Perth to Aberdeen; and wherein, then, could the monopoly of a railway from Mirzapore to Delhi be diminished by the formation, by a different company, of a railway from Delhi to Mirzapore? Monopoly is not diminished in amount by being broken into fragments, but, as it becomes more impalpable, it becomes more obnoxious. To any kind of monopoly in locomotion we have always been opposed, and with the example of the intolerable oppression of the railway monopolies in this country, we trust the Indian government will take effectual precautions against the introduction of such a system into India. But these precautions are afforded, not by a multiplication of companies, but by restricting the profits of each by providing that the government shall have access to the books, and insisting on the condition that whatever lines may be constructed shall be formed under Government supervision, aud shall be hereafter purchasable by the Government at a fair valuation. It is not difficult, we are aware, to evade any condition respecting the restriction of profits, and it is therefore worthy of consideration, whether instead of providing that all above a certain rate per cent. went to the Government, it would not be preferable to award only a portion of the sum in a ratio increasing with the dividend, so that the company would still have an interest in making the profits as large as possible. The Government should have a controul over the rates charged for the conveyance of passengers and merchandize, which should be gradually diminished until the railway attracted to itself the conveyance of the agricultural produce, whereby a larger revenue is to be realized with greater advantage to the country than if a high rate of charge were to shut it out. With these concessions we think it only reasonable that the Indian Government should guarantee to the railway company the moderate interest upon their money of 4 per cent.; for the money necessary for the construction of Indian railways must be raised in England, and we should suppose that it would be difficult, without such a guarantee, to collect the capital necessary for the purpose. A difficulty might perhaps be supposed to be presented by the uncertain tenure of the East India Company's charter; but in an affair of so much importance, the English Government would be singularly remiss or impracticable if it failed to delegate the powers necessary for the accomplishment of such an object; for such interventions in reality constitute the most important of the functions a government has to perform.

The constitution of the East India Railway Company is, we think, a favourable one for introducing railways into India with success. The governing directory will be located in England, and efficient paid servants will be chosen in India for carrying its instructions into effect. This arrangement—independent of its obvious sequency from the almost exclusive use of English capital—is rendered expedient by the fact, that joint stock companies have never been known to succeed in Calcutta, but have, in every case, become the theatre of jobbery and intrigue. Oriental morality appears to be of too lax a quality to render possible the success of the undertakings entrusted to its guardianship; and it appears indispensable therefore that the management of the proposed company should be undertaken by English merchants, who have already given proof of their eligibility for such a trust. The value of money in India is much too great to encourage the expectation that much of the capital for railways will be subscribed there—though indeed the effect of the introduction of railways will be to double or quadruple the capital of the country, by enabling the interchanges of commerce to be effected three or four times more rapidly than before. Bnt this effect cannot be antecedent to the instiution of railways, and on the resources of English capital the formation must depend. With these cursory remarks we must at present dismiss this important subject; bnt we trust on an early occasion to be able to turn to it again and acquit ourselves of the duty with greater success.

## Art. VII.—ANALYSIS OF BOOKS.

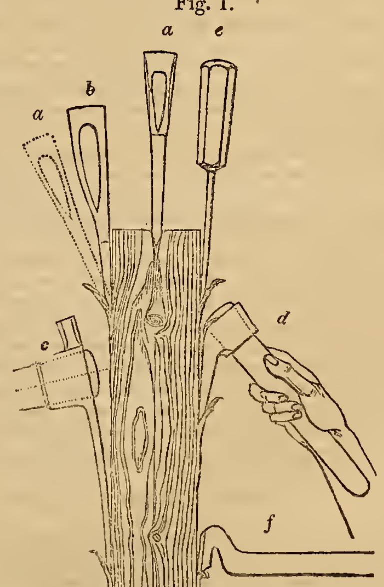
*Turning and Mechanical Manipulation: Intended as a work of General Reference and Poactical Instruction on the Lathe, and the various Mechanical Pursuits followed by Amateurs.* By Charles Holtzapffel. Volume the Second. London: Holtzapffel, 64 Charing Cross, 1846.

This is the second volume of Mr. Holtzapffel's work, on Mechanical Manipulation, of which the first volume was noticed in the first number of the Artizan, and of which four volumes have yet to appear. Of the first volume it may be in the recollection of our readers, we expressed a highly favourable opinion, and the quality of the second volume is correspondent to the excellence of the first, and adds weight to the opinion of its merit we have already recorded. In truth, there is no work on the subject of Mechanical Manipulation, although so much has been written upon its various departments, fit to be put in competition with this work of Mr. Holtzapffel's, and if the termination be only worthy of the commencement, of which, if the life and health of the writer be vouchsafed to us we can have no apprehension, it will constitute an enduring monument of his skill and industry, that will transmit his name to distant generations. The work, indeed, is little less than an Encyclopedia of mechanical art in its application to most of the processes and operations carried on in the workshops of this busy country, and its authorship involves a comprehensiveness of information, and a speciality of practical detail, which could hardly have been expected to co-exist in the same individual. But there is another consideration which adds still further to the obligations under which the public have been laid by Mr. Holtzapffel. Such a work, to have all the freshness and practical fidelity of this treatise, could only have been produced by an accomplished mechanic in active occupation, and such a man in undertaking the labours of authorship, must be sacrificing time for which he could no doubt find more emolumentary employment. The explanation of this sacrifice may be found in the hypothesis, which is in all probability the just one, that Mr. Holtzapffel recognizes in his art more than the pursuit of a trade, and that in common with our Maudlays and Millers, and other distinguished mechanicians, he loves his profession for its own sake without reference to its commercial results, and would willingly make considerable sacrifices for its improvement. Fortunately for those who yield to the impulses of this generous spirit, its indulgence is conducive, within obvious limits, to commercial success, for unless mechanicians be something better in these times than mere forgers of iron, or polishers of steel, they will win neither confidence nor employment.

The volume before us opens with some general remarks upon cutting tools, shewing that they may all be ranged under the heads of Paring tools, Scraping tools, and Shearing tools. Some very valuable observations are then given on the subject of Chisels and Planes. We must give an extract from what is said about chisels:—

"In fig. 1 are drawn to one scale several very different paring tools, which agree however in similitude with a type, previous, and also corroborate the remark, that 'in the paring-tools, the one face of the wedge or tool is nearly parallel with the face of the work.' In tools ground with only one chamfer, this position not only assists in giving direction to the

Fig. 1.

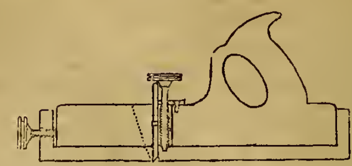


tool, but it also places the strongest line of the tool exactly in the line of resistance, or of the work to be doue. For example, the axe or hatchet with two bevils *a*, fig. 1, which is intended for hewing and splitting, when applied to *paring* the surface of a block, must be directed at the angle *ȧ*, which would be a much less convenient and less strong position than *b*, that of the *side hatchet* with only one chamfer; bnt for paring either a very large or a nearly horizontal surface, the side hatchet in its turn is greatly inferior to the adze *c*, in which the handle is elevated like a ladder, at some 60 or 70 degrees from the ground, the preference being given to the horizontal position for the surface to be wrought. The instrument is held in both hands, whilst the operator stands upon his work in a stooping position, the handle being from 24 to 30 inches long, and the weight of the blade from 2 to 4 pounds. The adze is swung in a circular path almost of the same curvature as the blade, the shoulder-joint being the center of motion, and the entire arm and tool forming as it were one inflexible radius; the tool therefore makes a succession of small arcs, and in each blow the arm of the workman is brought in contact with the thigh, which thus serves as a stop to prevent accident. In coarse preparatory works, the workman directs the adze through the space between his two feet, he thus surprises us by the quantity of wood removed; in fine works, he frequently places his toes over the spot to be wrought, and the adze penetrates two or three inches beneath the sole of the shoe, and he thus surprises us by the apparent danger yet perfect working of the instrument, which in the hands of the shipwright in particular, almost rivals the joiner's plaue; it is with him the nearly universal paring instrument, and is used upon works in all positions.

"The small Indian adze or Bassōōlāh *d*. fig. 1, in place of being circular like the European adze, is formed at a direct angle of about 45 or 50 degrees; its handle is very short, and it is used with great precision by the nearly exclusive motion of the elbow joint.* In order to grind either of these adzes, or *percussive* chisels, it is necessary to remove the handle, which is easily accomplished as the eye of the tool is larger externally as in the common pickaxe, so that the tool cannot fly off when in use, but a blow on the end of the handle easily removes it. The chisel *e*, admits of being very carefully placed, as to position, and when the tool is strong, very flat, and not tilted up, it produces very true surfaces as seen in the mouths of planes. The chisel when applied with *percussion*, is struck with a wooden mallet, but in many cases it is merely *thrust* forward by its handle. It will shortly be shown that various other forms of the handle or stock of the chisel, enable it to receive a far more defined and effective thrust, which give it a different and most important character. The *paring-knife* exhibits also a peculiar but most valuable arrangement of the chisel, in which the thrust obtains a great increase of power and control; and in the *drawing knife*, the narrow transverse blade and its two handles form three sides of a rectangle, so that it is actuated by *traction*, instead of by violent percussion or steady thrust. The most efficient and common paring-tool for metal, namely *f*, has been added to fig. 1 for comparison with the paring-tools for wood; its relations to the surface to be wrought are exactly the same as the rest of the group, notwithstanding that the angle of its edge is doubled on account of the hardness of the material, and that its shaft is mostly at right angles, to meet the construction of the slide rest of the lathe or planing machine. The chisel, when inserted in one of the several forms of stocks or guides, becomes the plane, the general objects being to limit the extent to which the blade can penetrate the wood, to provide a definitive guide to its path or direction, and to restrain the splittiug in favour of the cutting action."

We are unable to give any citation from the remarks upon planes, but may briefly enumerate the chief facts recorded. The wedge of the plane which fixes the iron is generally at the angle of 10°, and in all bench planes the iron is somewhat narrower than the stock, though in some of the narrow planes the iron is of the full width of the sole. The sole of the plane rests on the surface of the work, and the cutting blade projects a distance beyond it equal to the thickness of the shaving; while the mouth of the plane, or the open space in advance of the iron determines the extent to which the fibre of the wood can break up iu advauce of the cutting blade. The plane irons are usually ground at 25°, are sharpened on the oil-stone at 35°, and are set in the stock at an angle of 45°, so that the ultimate bevel lies at an angle of 10° from the surface to be planed. The use of the top iron of the plane which is screwed to the cutting blade, is to break the shavings, whereby they are more effectnally bent out of the way of the cutting tool, and there is less of the splitting action when it is used, so that the work is smoother, though the plane is more heavy to move. Planes for brass and iron have perpendicular cutters, as shewn in Fig. 2. Here the

Fig. 2.



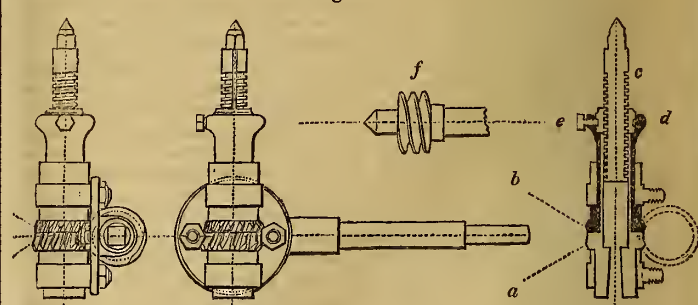
necessity for the narrow mouth ceases, and the cutters are sometimes groved on the face, so that each cutter virtually becomes several. The work is finished, however, with a smooth cutting edge, and the width of the cutter rarely exceeds 1 inch.

Various machines for planing wood have, at various times, been contrived, some of which are in extensive use for planing flooring and other straight boards. In 1802 Mr. Bramah patented a wood-planing machine, and a machine erected by him for planing timber has long been in operation in Woolwich Arsenal. The timber is passed under a large wheel revolving horizontally at about 90 revolutions per minute, and the face of the wheel is armed with a succession of 28 gouges, of which the first is a little more distant from the centre, and a little more elevated than the next, and so on through the whole number. The work is finished by flat irons. In a more recent machine, knives are placed on the circumference of a small cylinder parallel with the axis, and the cylinder is put into rapid revolution while the board is passed beneath. In Muir's machine, both surfaces are planed simultaneously by rotary adzes, and the board then passes between fixed plane irons, each of which takes off a shaving the whole length and breadth of the board.

We are net able to follow Mr. Holtzapffel in his remarks upon turning tools and drills, as they will not bear abridgement, and are of too great a length to be introduced in full. We may here, however, introduce Mr. Holtzapffel's account of the drill tool, lately contrived by Mr. Shanks, of Glasgow—a very elegant instrument, as it appears to us, and one which deserves a larger notoriety than it has yet reached, and a more extensive adoption.—

"This instrument is represented of one-eighth size, in the side view, fig. 3, in the front view, and in the section; it is about twice as powerful as

Fig. 3.




the winch and as the advantage of feeding the cut by a differential motion. The tangent screw moves at the same time the two worm wheels *a* and *b*; the former has 15 teeth, and serves to revolve the drill; the latter has 16 teeth, and by the difference between the two, or the *odd tooth*, advances the drill slowly and continually, which may be thus explained:—The lower wheel *a*, of 15 teeth, is fixed on the drill shaft, and this is tapped to receive the center-screw *c*, of four threads per inch. The upper wheel of 16 teeth is at the end of a socket *d*, (which is represented black in the sectioned figure) and is connected with the center-screw *c*, by a collar and internal key, which last fits a longitudinal groove cut up the side of the screw *c*; now therefore the internal and external screws travel constantly round, and nearly at the same rate, the *difference* of one tooth in the wheels serving continually and slowly to project the screw *c*, for feeding the cut. To shorten or lengthen the iustrument rapidly, the side screw *e* is loosened; this sets the collar and key free from the 16 wheel, and the center-screw may for the time be moved independently by a spanner. The *differential screw-drill*, having a double thread in the large worm, shown detached at *f*, requires $7\frac{1}{2}$ turns of the handle to move the drill once round, and the feed is one 64th of an inch for each turn of the drill; that being the sum of 16 by 4."

The next subject discussed by Mr. Holtzapffel is that of screw cutting, in which he enters into the historical question of the improvements in screw

* "This very useful instrument says Sir John Robinson varies a little in different districts. in weight and in the angle which the cutting face forms with the line of the handle, but the form shown is the most general, and the weight averages about 1 lb. 12 oz. The length of handle is about twelve or thirteen inches, and in use it is grasped so near the head, that the forefinger rests on the metal, the thumb nearly on the back of the handle, the other fingers grasp the front it, the nails approaching the ball of the thumb. The wrist is held firmly, the stroke being made principally from the elbow, the inclination of the cutting face being nearly a tangent to the circle described by the iustrument round the elbow joint as a center, the exact adjustment being made by the grasp and the inclination of the wrist, which is soon acquired by a little practice. In this way very hard woods may be dressed for the lathe with a degree of ease and accuracy not attainable with the small axe used in this country."

cutting, effected by Maudslay, Barton, Clement and others, and describes at length the modes of procedure they pursued. The method of originaing screws adopted by Mr. Maudslay, consisted in centering a cylindrical bar truly turned in the lathe, and then applying a knife-edge, hollowed to fit the cylinder and set at the angle required for the screw, to the turned surface. This knife-edge was fixed to the slide rest, and when the cylindrical bar was put into revolution, the knife travelled on in the direction of the axis of the bar of its own accord, and the screw was thus originated. Barton improved his screws by employing two pairs of dies upon the one screw, which redressed one anothers defects. Screws are now usually cut in screw-cutting lathes, of which there are a great variety. That of Mr. Shanks, in which the tool cuts both in the advance and return, the rest, Mr. Holtzapffel describes as follows:—

"Sometimes, with the view of saving the time lost in running back, two tools are used, so that the one may cut as the tool slide traverses towards the mandrel, the other in the contrary direction. Mr. Shanks' arrangement for this purpose, as applied to the screwing of bolts in the lathe, is shown in

Fig. 4.

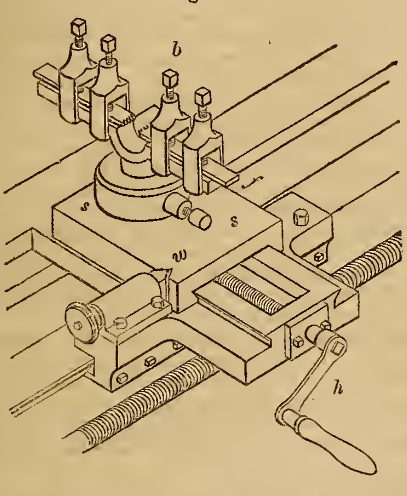
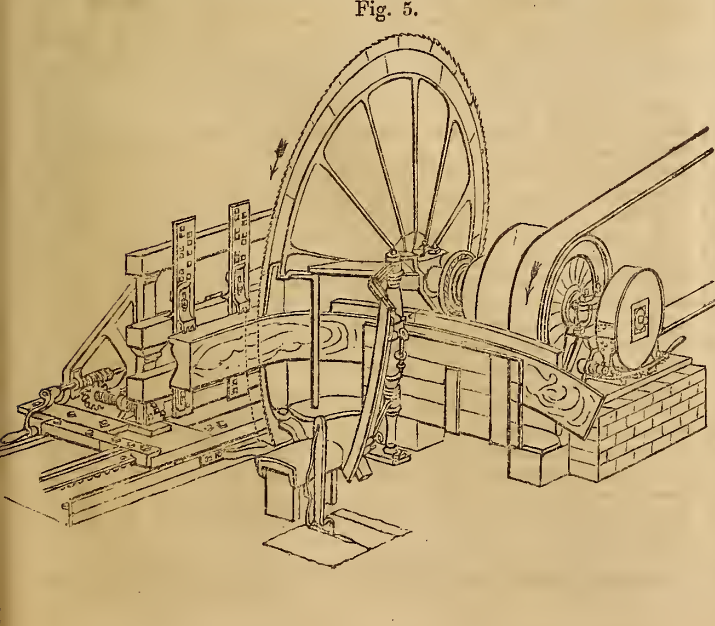



fig. 4, *f* represents the front, and *b* the back tool, which are mounted on the one slide *s s*, and all three are moved as one piece by the handle *h*, which does not require any micrometer. In the first adjustment, the wedge *w*, is thrust to the bottom of the corresponding angular notch in the slide *s*, and the two tools are placed in contact with the cylinder to be screwed. For the first cut, the wedge is slightly withdrawn to allow the tool *f*, to be advanced towards the work; and for the return stroke, the wedge is again shifted under the observation of its divisions, and the slide *s s*, is brought forwards towards the workman, up to the wedge; this relieves the tool *f*, and projects *b*. which is then in adjustment for the second cut; and so on alternately. The command of the two tools is accurately given by the wedge, which is moved a small quantity by its screw and micrometer, between each alternation of the pair of tools, by the screw *h*."

Fig. 5.



The next subject Mr. Holtzapffel discusses, is that of laws, and the present volume closes with disquisitions on files and shears. In these [illegible]ters there is a large fund of most valuable information, but our sp[illegible]e prevents us from giving even any specimen of it. Fig. 5, is a circular saw, such as is used for sawing veneer, in which, instead of a disc of steel, with serrated edges, saw-formed segments affixed to a cast-iron wheel are adopted.

Such then is a faint outline of the contents of Mr. Holtzapffel's second volume on Mechanical Manipulation. It is a Treasury of Mechanical knowledge, from which the mechanic, whether skilful or unpractised, illiterate or informed, may draw large and precious instruction. Why is not the work issued also in numbers, so as better to bring it within the reach of working men? As yet it is far too little known; and a little more advertisement is necessary, and a little better adaptation of the issue of the work to the financial circumstances of those it chiefly addresses, before it can gain such a circulation as it ought to gain, or an appreciation equal to its deserts.

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## Art. VIII.—NOTES OF THE MONTH.

*Inutility of the Gun Cotton for Large Guns.*—Mr. W. Greener has addressed a letter to the *Times* shewing that, inasmuch as the superior facility of explosion in the case of Gun Cotton is attributable to the more intimate union of its constituent nitre and carbon, it is assimilated in its action to fine grained gunpowder, which has been found by experience to be unsuitable for large guns. We transcribe a portion of Mr. Greener's letter:—"Sulphur is an adjunct not absolutely necessary, save as an agglomerating substance, to give an enduring consistency to the grains of gunpowder. Experiments have shown gunpowder to be equally propellant without this agent as with it. Sir Humphry Davy discovered that gunpowder, formed mechanically into the smallest state of grain or granulation possible, gave a much more instantaneons explosion than when in a larger grain. The principle is, that the smallest grains present the greatest amount of surface, a greater number of interstices to be acted upon by the flame, and hence the whole is converted into explosive fluid simultaneously. Experience has shown this discovery to be perfectly worthless in practice, as conviction has gradually returned to the fact that gunpowder, to be beneficially employed in the expulsion of projectiles, must be made of a grain proportionate to the size of the gun used. In sporting gunpowder, there are three or four sizes of grain; in artillery, a very much larger grain is necessary. Why? That the grain may burn longer, to keep giving out fresh expulsive matter, until the larger mass of projectile is put into motion, and to continue this generation of force until it has reached the highest states of velocity. This slight introduction brings us to the fact that gunpowder, to be beneficial, must be a propellant, moderated in its explosive tendency by mechanical means. We possess a knowledge of explosive materials vastly more powerful than gunpowder, but, from this very fact, quite useless as a projectile force. This has been sufficiently tested on many occasions. The discovery of the gun cotton is the extreme diffusion of nitre in immediate contact with charcoal, or, more properly speaking, carbon, the ingredients of which exist in the most minute portions that can be conceived, the nitre in solution, the carbon in the smallest particles, many thousand times more minute than ever attempted (or possible) to be obtained by any other means whatever. The action of the acid upon the cotton, when immersed in it, is to remove the small proportion of vegetable matter, and to impregnate the remainder, which is nearly all carbon, with nitre; thus forming by the simplest means the most perfect incorporation of the explosive agents, and exposing an amount of surface to the action of the flame greater than obtainable by any other means yet discovered. It will be perceived this is but the extension, to an enormous extent, of Davy's scheme of small granulation; for it is but the simultaneous liberation of the gases of gunpowder by mechanical agency; there is no new power obtained; its action is thus powerful by its instantaneous ignition. The low temperature at which it is ignited arises from the minuteness of the particles brought in contact with the heating agent. The reason of its being exploded over granulated gunpowder, without igniting it, is, that its explosion does not endure sufficiently long to raise the particles of gunpowder up to 600 degrees of heat; but could the gunpowder be reduced to the most impalpable state of powder, similar to the cotton wool, it would explode with the same degree of heat. Sporting powder explodes at a less temperature than cannon powder, and so on, all depending on the quantity of matter heated. Another point, that 40 grains of the gun cotton effects more force or gives more velocity (to small projectiles) than 50 grains of gunpowder, may be explained by two facts,—first. its instantaneous explosion, secondly, filling a greater space, or being more bulky than the gunpowder in grain, it gains the aid of the expansion of the air contained within its interstices, and a corresponding velocity acquired. But that the same weight of the one will generate the same amount of permanent gases as the other is a chymical certainty; therefore, we are justified in asserting the discovery to be a really mechanical means of diffusing and incorporating the agents of explosion. The just estimation of these facts must impress us with the conviction that, save for very limited purposes, this discovery can never benefit the human race, and is certain to cause many lamentable accidents; no gun ever made will long withstand its use, if quantity is employed, as the intensity of its velocity brings it on a perfect similarity with the fulminating compounds; these will project small projectiles with great velocity a given distance, but to obtain an extended range is impossible, with safety." It would appear from these remarks that the Gun Cotton is more suitable for blasting than for guns. Another disqualification for the latter use appears to be, that as it explodes at a moderate heat, a gun, when heated by firing, can no longer be used with safety. Some of these objections however, may perhaps be remedied by future discoveries.

*The Steamer Sphynx.*—This is a steam frigate, the engiues for which have been constructed by Messrs. J. Penn and Son: we lately visited the vessel when the engines were at work, and shall here state the impression produced by our survey. The engines are of the oscillating description, and they are the largest yet constructed, the cylinders being 82¼ inches in diameter, and the length of the stroke 6 feet. There are two air-pumps, which lie at an angle with the keel and with each other: they are both wrought off a crank in the intermediate shaft, and stand a little out of the line of the keel, so as to permit the connecting rods proceediug to the crank in the intermediate shaft to pass oue another. The valves are three-ported, and there are valves on each side of the cylinder, so as to cstablish an equilibrium, and obviate the necessity of a balance weight affixed to the cylinder, which is an inconvenicnt addition. Both the valves of each cylinder are wrought by the same arc and the same eccentric, so that there is no complication in the gearing. The eugines are fitted with the disc connecting gear, and the paddle-wheels are of the common description.

The workmanship of the engines of the *Sphynx* is—like all that comes from the hands of Messrs. Penn—of the very first quality; and the arrangement of the parts manifests a discriminating attention to symmetry, and satisfies the expectation of the most fastidious observer. The predominant feeling on enteriug the engine-room is, that the climax of simplicity has here been attained. There is no obstruction presented by machinery between the engsnes to a ready access to every part, and on the platform beneath the intermediate shaft, the only working parts are the rods proceeding to the air-pumps. The hot wells, usually rising to so high an elevation in marine engines, are here taken away altogether, so that, except the framing, the only parts of the machinery above the platform are the rods proceeding to the shafts. The *Sphynx* is 1,200 tons burden, aud, with a draught of water of about 15 feet, she realized a speed of 13 miles an hour. We wish we could say as much for the ship as for the engines, but it is like most of the steam vessels sent out of the Governmeut yards, which are heavy unwieldy tubs that no engines can drive. We observed supplementary pieces beneath the engine framing, rendered necessary by the weakness of the crank beams, which have not beeu trussed and strengthened in an efficient manner. The day must come when the dockyards will be shut up, for everything done that appears to be done in an antiquated and imperfect manner, and at a dear rate. The boilers of the *Sphynx* are on the tubular plan, the workmanship upon them is of the first quality, and they produce, we unperstand, an abundance of tteam.

*New Machine for Drawing Lead Pipe.*—A machine has been patented in America for drawing lead pipe, which exhibits much ingenuity, and appears likely to prove useful. The cylinder, from which the lead is forced through the matrix or former, is substantially a double acting force-pump, and is connected with an air chamber for the purpose of preserving a regular stream. This cylinder is located partly within the heater and partly within the furnace. By this construction the operation of forming the pipe can be continued any length of time—the cold lead being regularly supplied to the heater, and the end of the cylinder being filled by suction, while the lead is forced from the other into the air chamber, and thence continuously through the apparatus for forming and cooling the lead. By forcing the melted tin, during the formation of the pipe, into a tube in the core, and thence discharging it through numerous small openings on all sides of the mandrill upon the interior of the pipe, the pipe may be tinned internally.

*Substitute for Guano.*—Mr. Higgs has lately taken out a patent for the extraction of the fertilizing matters in sewage water, and their conversion into a solid manure, which displays considerable ingenuity, though we fear it will be found to involve too large an expense to be available in practice. The animal and vegetable matters in the sewage water are precipitated by means of lime, and the liquid filters through a horse hair fabric spread over the bottom of a suitable tank. From the filter the water passes away comparatively pure and limpid, leaving the fertilizing matter in combination with the lime, which is then dried and pulverized, so that it may be used in the same manner as guano. The gases escaping from the tank are intended to be condensed by means of chloaine. Mr. Higgs's plan seems to involve the erection of guano factories in towns, which would be very objectionable; but we fear the expense of the process, apart from other considerations, must prevent its introduction, even taking it for granted that it is productive of the desired effect.

*Turning Cast Iron into Steel.*—A patent has recently been taken out by Mr. Heath for decorburating pig iron to the degree requisite to form steel, by the addition of malleable iron to the cast iron when in the fluid state. Mr. Heath directs that the melted cast iron should be kept at the highest possible temperature., either by directing upon it a current of carbonic oxide, obtained by the imperfect combustion of any carbonaceous substance, or hydrogen, obtained by dropping water uyon pieces of red-hot iron. These gases are to be directed upon the molten metal with nearly enough hot atmospheric air for their complete saturation, and the malleable iron is then to be added in small fragments. The most convenient form in which the malleable iron can be, Mr. Heath says, is that in which pure oxide of iron, reduced to small fragments, has been recovered by cementation. The malleable iron, after having been brought to a white heat, is raked into a receptacle into which the fluid cast-iron has been run, and the whole is kept in fnsion aud stirred about sufficiently to produce perfect admixture. The molten mass is then run off into moulds of a suitable size and shape, and will be found to possess the qualities of cast steel. A vitreous flux should be used while the metal is in the receptacle, to prevent the surface from oxidation.

*Mr. Locke's views as to the cause of the Failure of the Barentin Viaduct.*—Mr. Locke's report to the Directors of the Rouen and Havre Railway respecting the failure of the Barentin Viaduct, has recently obtained publicity, and as the document is one of some interest we have thought it right to subjoin it. Mr. Locke it appears attributes the accident to the defective masonry of the stone footings of the piers. The report is as follows:—

Gentlemen,—We have found it necessary to employ several days in seeking out the cause of the unfortunate accident which has occurred to the viaduct of Barentin, and although some difficulty may still remain in assigning this cause with precision, still the observations that have been collected permit us to approximate to it to a certain point. To do so, however, it is indispensable to enter into some preliminary explanations. One and twenty piers of the viaduct of the Barentin were erected on rough stone and mortar, or on solid mason-work, on solid ground, at different depths from the surface; five piers only were placed on piles to the level of the ground; and four or five mètres above accordiug to the undulation of the soil the piers were composed of stones, and from that base up the whole viaduct was composed of bricks. At the period of the accident, all the arches were terminated, and the laying down of the ballast had been commenced. During the progress of the works, the stone-masonry at the base of some of the piers had shown a little depression, and some of the stones were split. The base of the pier No. 5, erected on pile-work, exhibited a fissure, which extended from the ground to the top of this base on both fronts. The evening before the accident this pier had been minutely examined by the resident engineer, and he remarked no movement or displacement in the stones, except the fissure of which I have just spoken. He also examined with great care the brickwork of the pier, and did not perceive the slightest cause for alarm. There was not, in fact, at this period, in the whole of the brickwork, the smallest appearance of separation, irregularity or fracture. He also took the level of the mason-work of the base, and could not discover any settling. All the arches fell in the two dirctions towards the pier No. 5, and this is a sure indication that the two arches adjoining it were the first to yield. In clearing away the ruins, there were found all confounded together, as might be expected, pier, arch, bricks and stonework, and only a few stones remained standing on the surface of the ground. As to the foundations, all the bases, except one or two close to the pier No. 5, have preserved fragments of the brickwork attached to them, without the slightest change of level or position; and after a most careful examination of the pier No. 5, and the two adjoining ones, it has been ascertained that they have not undergone the slightest movement. It is consequently certain that the foundations remain perfectly firm. I do not conceive that the quantity of ballast lying on the viaduct at the period of the accident was sufficient to displace the arch by an unequal pressure, as the depth of the ballast was ouly from 70 to 80 centimetres. According to these circumstances, the fall of the viaduct must be attributed to the mason-work in stone, forming the base of the pier, for, as far as we can form a judgment, there has never been any other apparent cause. The introduction of stone in the construction of this viaduct was posterior to the original plan. It took place at the express demand of the contractors, as superior to brickwork, against which an unfavourable feeling existed in France, and also because the contractors did not possess a sufficient quantity of bricks to construct the viaduct altogether of such material within the time fixed. I offered no objection to this demand, for I was convinced that it was not made with a view to economy, but from a desire to strengthen the mason-work and to avoid a delay. I made no other stipulation than that which I always insist on in similar cases—that no materials should be substituted of a quality inferior to that prescribed by the treaty—and I certainly had reason to expect that better mason-work should be employed in the piers, than that which appears to have been made use of. Taking into consideration the manner in which the contractors have admitted their responsibility relative to this work, and their readiness to repair it, I need not add any other explanation on the subject. I should be sorry to make a single remark that could augment the annoyance they feel, or diminish the confidence hitherto accorded them.

Joseph Locke.

*The Neapolitan Steamer Caprin.*—We lately visited a very handsome iron steam vessel, constructed by Messrs. Ditchburn and Mare for the Neapolitan Steam Navigation Company, and which has realized, we understand, the great speed, for a sea going vessel, of 17 miles an hour. The vessel is 605 tons, and 220 horses' power; the form is a very sharp and handsome one, and the paddles are of the feathering kind. The vessel will carry 200 tons of cargo, and has extensive accomodation for passengers. The performance of this vessel has been so satisfactory, and has given Messrs. Ditchburn and Mare such confidence in the capabilities of their vessels for speed, that they have offered to build four vessels for Government to carry the mails between Dublin and Holyhead, which shall realize a speed of 20 miles an hour.

*Commercial Value of the Fine Arts.*—Mr. G. Wallis, the late principal of the Manchester School of Design, lately delivered a lecture at Bradford, wherein he shewed the money value of the fine arts in their application to industrial purposes. A jug which he exhibited, the material of which would cost about a farthing, was raised to the value of half-a-crown by the taste displayed in the form and design, and another jug of the same material was raised in value to 5*s.* 10*d.* by the beauty and tasteful combination of the colours employed in its decoration. In England, Mr. Wallis remarked there was an indisposition, from the non-appreciation of works of art, to pay the high price for their embellishment which our continental neighbours, whose taste was educated, paid for them; yet Englishmen he said would produce works equally beautiful in the art of design as the French, when they had equal encouragements and when the people could appreciate the truly beautiful. The English manufacturer seemed to lose sight of the fact that, if he produced a costly article, he must look to his customers for an increased return for the outlay made, in order to increase the value of the raw material; for instance, there was a beautiful design in paper before them; the English manufacturer dare not attempt to produce it, if it would take more then twelve blocks, in order to print it, but this design would take 450 blocks, and the French manufacturer produced it, because he knew its value would be appreciated amongst a people who had a love of art, and he would find a ready sale for it. Much of the defective taste of the public in such matters is, however, attributable it appears to us to the supineness of the manufacturer, who finds it an easier thing to copy than invent, and who, consequently, must be behind the nation whose works are copied. But a necessity for exertion has now arisen from the relaxation of commercial restrictions, which will enable the Foreign to compete with the English designer on more equal terms, and favourable results may be expected, from the removal of that barrier to all improvement Protection. Mr. Wallis said, that as a proof that there was no lack of ability in England, for the successful cultivation of the arts of design he might mention that with several Government schools of design in this country, he had found only four persons, out of the large nuuber of 1,500, who had an incapacity to make any progress. If he were to state that, among this number, there were fifty more whose friends he would have advised not to let them engage in such studies, he would be exceeding the number. From this it would appear, that it is not an importation of exotic talent that is wanted to make our arts of design flourish, but only appropriate instruction.

*Recipe for the production of Gun Cotton.*—We gave in our last number, Dr. Otto's recipe for the preparation of Gun Cotton. We shall now describe another method of preparation lately furnished by a correspondent of the *Times*. The writer is Mr. Thomas Taylor, of Bridge-street, Blackfriars:—Mix in any convenient glass vessel 1½ ounce by measure of nitric acid (sp. gr. 1·45 to 1·50) with an equal quantity of sulphuric acid (sp. gr. 1·80.) When the mixture has cooled, place 100 grs. of fine cotton wool in the Wedgewood mortar, pour the acid over it, and with a glass rod imbue the cotton as quickly as possible with the acid. As soon as the cotton is completely saturated, pour off the acid, and with the aid of a pestle quickly squeeze out as much of the acid from the cotton as is possible. Throw the mass into a basinful of water, and thoroughly wash it, either in successive portions of water, or underneath a tap, until the cotton has not the slightest acid taste. Finally, squeeze it in a linen cloth, and dry it in a water bath. By employing a large relative proportion of the acids to the cotton, or by using stronger nitric acid, a still more highly explosive compound may be produced.

*Improvements in the Apparatus for Impregnating Meat with Brine.*—A patent has been taken out in America, by Dr. Lardner and Mr. Davidson, for an improved apparatus for impregnating meat with brine. The meat to be impregnated is placed in an air-tight vessel, the brine is then introduced from a cistern above through the bottom, which expels the air through a valve at the top; the cock which admits the brine at the bottom is then closed, und the brine pumped out of the vessel by a suction pump thus leaving the provisions in a vacuum. The brine is then again admitted. The force pump is used at first to expel the air by forcing in the brine, but this is not required afterwards. The inventors state that their claim lies in the manner in which they have arranged and combined the respective parts of the apparatus for salting or impregnating provisions with any desired solution, as set forth; that is to say, they claim the combining of a common lifting pump, and of a force pump, with the vessel and with the cistern, substantially in the manner and for the purpose already described. There is not much novelty in this device. Similar plans have been tried in England, but dry salting appears to be preferred by our cure rs, to the method of salting by means of brine, and to drysalting the plan is not applicable.

*Layards Architectural Discoveries in Mesopotamia.*—At a late meeting of the Institute of British Architects, a paper was read by Mr. Mair, 'On an Ancient Structure existing at Al Hather, in Mesopotamia: and on some Antiquities recently discovered by A. H. Layard, Esq., at Nimroud;'—the description and drawings having been forwarded by that gentleman. Of the building at Al Hather, which appears to have been a palace and a temple, considerable remains still exist. They were visited by Mr. Ross, the surgeon to the British Residency at Bagdad, in the year 1837; and again by Messrs. Ainsworth, Mitford, and Layard, in 1840,—when the latter gentleman took the dimensions and made the drawings exhibited by Mr. Mair. As to the precise date of the origin of this building, there is a difference of opinion; but Mr. Layard conceives that it owes its origin to the Sassanian dynasty of Persian kings. At the time of Jovian's retreat, the city was deserted; but, as the character of the ruins in question is that of a later date, it is probable that, after the treaty of Dura, the Persians, seeing the importance of Hatra or Al Hather, rebuilt and strongly fortified it. By an inscription repeated more than once upon the walls of the palace, it appears that that building was restored in the year of the Hegira 586 (A.D. 1190). The period of its final desertion is not known. The resemblance of these ruins to those at Ctesiphon is striking. To this day, the mode of construction adopted by the Sassanian Kings of Persia has been preserved in most parts of the country;—the centre of the edifice being usually occupied by a hall of large dimensions, which extends the whole depth of the building, and is open only at one end. It is called the Aiwam; and is flanked by a number of smaller rooms, generally forming two stories. The whole structure usually stands in the midst of a large court-yard, ornamented with gardens, fountains and reservoirs. Mr. Mair next read a letter from Mr. Layard, descriptive of the modes of construction discovered at Nimroud. Slabs of marble, highly sculptured, are placed against intervening walls of sun-baked bricks. The roof was, probably, flat, and constructed entirely of timber. Ornaments and rings of ivory, copper, and porcelain are found among the ruins. The rooms are paved with either slabs of marble, layers of bitumen, or bricks. In some parts of the building, glazed and *painted* bricks occur;—the ornaments of which are extremely elegant, and the colours very brilliant.

*Telescope Bridge over the Arun.*—This is a timber draw-bridge, designed by Mr. Rastrick, for carrying the Brighton and Chichester Railway over the river Arun. The bridge consists of a timber platform 144 feet long, 12 feet wide, and weighing 70 tons, which is strongly trussed by means of timber diagonals 35 feet high. The platform runs upon sixteen wheels, six feet in diameter, and at one end is a supplementary platform which runs sideways, and the function of which is to fill the vacuity left by the bridge when drawn across the river, and thus re-establish the connexion This supplementary platform makes the total length of the bridge is 273 feet. The end of the bridge overhangs 60 feet, and adjusting screws have been provided to raise up the end, by means of the central truss, in case it may warp or sink.

*Breakwater Harbour at Brighton.*—A most influential meeting of the gentry and inhabitants of Brighton was held at the Town-hall, a few days ago, on the requisition of the High Constable (Mr. W. Catt, jun.) to receive a communication from the Chain Pier Company, respecting their intention to construct a fixed breakwater at the south end of the chain pier, to afford shelter to ships, steam packets, &c., and to faciltate the embarking and disembarking of passengers and goods. Captain Pechell, M.P., was present and the following attended as a deputation from the Chain-pier Company,—Captain Sir S, Brown, projector of the chain-pier; Rear Admiral Sir C. Malcolm; Mr. T. West, of Brighton, banker; and Mr. C. Cooper, solicitor to the company. The latter gentleman reminded the meeting that the directors of the London and Brighton Railway were about to expend 20,000*l.* in the improvement of Newhaven Harbour, the result of which would be, if nothing were done for Brighton, that the passenger traffic with France would be diverted to Newhaven, particularly as a line of railway was now in progress from Keymer through Lewes to that port. Sir S. Brown had designed the plan of a breakwater adapted to the coast, which the pier company had determined to construct, but before doing so they had thought it proper to consult the railway directors and the town of Brighton. The cordial consent of the directors of the railway had been obtained to the project, and if the town concurred, no doubt remained that the scheme would be carried out. The directors of the pier company had given the notices and prepared the plans requisite to enable them to go to Parliament in the present session. Sir S. Brown then gave a description of his project, which was illustrated by a model of a section. The breakwater would be about a quarter of a mile south of the pier, and would extend about the same distance in a crescent form from east to west. This would afford shelter for steam packets of all classes, and access to the pier at all times of the tide, and it would enable fishing boats to take shelter within its limits, when it would be either impracticable or extremely dangerous to run through the breakers to land upon the beach. Sir Samuel then entered into a minute explanation of his proposed breakwater, and was followed by Sir C. Malcolm, who said that he agreed with Sir E. Codrington in thinking that Sir S. Brown's project would be successful.

*Platinising Copper.*—The "Phamarceutical Times" gives some instructions for the platinising of metallic vessels for chemical purposes by the moist way. It is best to use a dilute solution of the double chloride of soda and platina. Three immersions suffice; between each immersion it is necessary to dry the surface with fine linen, rubbing rather briskly, after which it must be cleaned with levigated chalk before re-immersion. When copper has been gilded in the moist way the gilt surface has not a beautiful tint; but, if the copper be previously covered with a pellicle of platina, a very beautiful golden surface may be produced.

*Loss and proposed Recovery of the Great Britain.*—The circumstances attending the wreck of the Great Britain have been so fully discussed in the daily papers, that we shall not trouble our readers upon the subject, contenting ourselves with stating one of the most ingenious of the various schemes that have been proposed for removing that vessel from her perilous position. Mr. Macintosh, of water-proofing notoriety, suggests the formation of an artificial tide to carry the vessel into deep water. This he means to effect by enclosing the ship on the land side by an embankment, against which, are secured open-mouthed vessels containing water-proofed bags of powder, and directed to the ship. These water cannon being fired simultaneously, will form an immense wave, which rolling seawards, will carry the vessel with it. This artificial flood tide may be continued by a repetition of explosions, and sufficient water being thus obtained, the tugs may readily carry her out of danger. To provide against any damage which the vessel may have sustained, empty casks are so fastened down in the hold of the vessel as to ensure her buoyancy.

*Punching and Rivetting by Hydraulic Pressure.*—Mr. Charles May, of Ipswich, has contrived a punching and rivetting machine, in which the die or punch is urged by hydraulic pressure, and we think the contrivance is likely to prove beneficial and to come into extensive use. The machine consists essentially of a very large and strong piece of iron of horse shoe form, and at one arm of which the die or punch is placed, while on the other arm, and facing the die or punch, is the hole or surface on which the pressure is received. The extremity of one arm of this horse shoe is cast hollow, and is fitted with a ram or plunger, to which is affixed the punch or die. The horse shoe iron is furnished with rings by means of which it may be hung up and tied in any convenient position, but no foundations or heavy attachments are required, as the action of the strain is not to shift the horse shoe from its place, but to tear the arms asunder. Mr. May, in the application of a hydraulic press, to stamping and punching, has been anticipated by Bramah and others; the mechanical details of his plan too, have a needless complication, yet we think the hydraulic application a beneficial one, and one that is likely to come into use.

*Iron Ship-building at Aberdeen.*—The engineers of Aberdeen are not behind their southern neighbours in the construction of iron vessels. A week or two since a fine iron schooner was launched from the building-yard of Messrs. Wm. Simpson and Co., Engineers, of York Place Iron Works. This vessel is the property of the Aberdeen, Leith and Clyde Shipping Company, and is very substantially built.

*Palatial Shops.*—Our American friends seem to be outstripping us in the magnificence of their street architecture. At New York a haberdashery establishment has been recently completed which is said to be a third larger than any of the new club-houses in London. It is a vast structure of marble, with a facade of fluted columns, fronting Broadway. The interior rises into a dome, with an imposing circular gallery and staircase leading to the upper warehouses and shops; the walls and ceilings are painted in fresco. About 100 young men are employed in this establishment, who have each a separate room in a boarding-house, built by the proprietor, which is furnished with baths, a library, and school rooms, where languages and other branches of mercantile education are taught. It is to be hoped that this example will be emulated by others.

*Agency of Sulphur on the Natural World.*—Some interesting investigations were recently brought before the Paris Academy of Sciences by M. Dumas, relating to the agency of sulphur, which exists in the proportion of one-hundredth part of the entire weight of all azoted animal and vegetable substances. Whenever sulphates exist in contact with organic matter, sulphuretted hydrogen is formed; and wherever sulphuretted hydrogen and the air are in contact with humid organic matter, sulphates and sulphuric acid will be formed. Sulphur may thus be carried in masses of vapour to lands where its presence is necessary for the production of plants and animals. If these views be supported, they will afford another illustration of the phenomena of conversion and re-conversion which obtain throughout the natural world.

*Submarine Navigation.*—The *Liverpool Mercury* contains a vague account of a machine at present in course of construction at Toxteth Park, which, it is conjectured, is for the purpose of submarine navigation, though its purpose is as yet kept secret. It is 120 feet long, and in shape it somewhat resembles a bagpipe—the upright tubular portion being at the largest part about 36 feet in circumference. The propelling power will be situated at the hinder part or stern. At the fore end a small room is to be fitted up in a superior manner with a sofa and a large looking-glass in a glass door. This room, in addition to the light which it will receive from the door, will be lighted by a window at the top, which is also to serve as a look out. At one side of the room there is a small staircase leading from what it is supposed is meant for the public saloon, which it is said will accommodate upwards of 140 persons to the look-out. The large room will be lighted by panes of thick glass, and will also be fitted up in an elegant and tasteful style. We think the passenger part of such a machine might have been dispensed with for the present, as we believe it will be found that few persons have faith enough to trust themselves to the embrace of so ambiguous a bell.

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## ART. IX.—LETTERS TO THE CLUB.

*Labour and Capital.*—The views you propounded about two years ago in the *Artizan* respecting the relations of Labour and Capital to Land, and to each other, are now, I see, gaining a wide acceptation. In some of the late numbers of *Douglas Jerrold's Newspaper*, some very able articles are given on these and kindred subjects, from which I have prepared some extracts which I wish to set before your readers, as they are in perfect accordance with your views, while they go more fully than you have done into some of the branches of the subject. The belief is fast becoming a general one, that inasmuch as land is the material out of which labour elaborates wealth and subsistence, there is as much slavery interwoven with the condition in which land becomes the property of individuals as in that where human beings are bought and sold like beasts. Originally the land was the property of the State, and the possession of it was granted to certain persons on the condition that they paid the expenses of the State, which they now do no longer. It therefore appears to me that the possession of the land by the State should be resumed, and if it were then let out periodically, the rents received would defray all the taxes, and provide an adequate support for the poor. No doubt there would be much hardship to many persons from such a resumption, as they have purchased their land at a high price, but such persons would only be in the predicament of those who have bought property with a defective title, and in the case of entailed estates this plea could not be adduced. The entail would only operate retrospectively, and as it gives to the present generation the rights of their ancestors it must also entail their liabilities. It appears to me probable enough that the law of entail upon which the aristocracy have depended will work their ruin in the end—just as the Chandos clause in the Reform Bill, which they got introduced as their safeguard, became the instrument by which the Repeal of the Corn Laws was wrested from them. I must, however, proceed with my promised extracts, the first relates to the rights of labour and exchange.

"To labour diligently and exchange freely, are the only conditions imposed on man by his Creator, and, these fulfilled, all the bounties of this teeming earth are placed within his reach. The tendency of modern politics is to embody these truths in legislation, that they may receive a practical development; and our present purpose is to inquire how these principles may be best applied. To labour diligently, is the first condition. This implies a field for labour and a reward for its exercise. The former is found by private capitalists, and the latter is regulated by the law of supply and demand. This is the current doctrine held by the economists. But suppose the private capitalists are unable to find employment for all who present their industry for hire. Is labour, in that case, to be suspended? If so, a loss is entailed on the nation, since labour is the admitted source of all wealth, and consequently whatever arrests or diminishes its productive power, reduces the national stock. Moreover, they who are condemned to compulsory idleness, must nevertheless be subsisted, and what they consume and do not replace, increases the primary loss. In such cases, that is to say where the supply of labour exceeds the demand of the private capitalists, we contend that Government is bound to intervene and find employment on national works of public utility. The organization of national armies, in the manner proposed, is not a poor law in disguise, as one of our correspondents affirms, since an equivalent is received for the wages paid. Will it be asserted that the pay of the army and navy, or of the workmen and artificers employed in the dock-yards and arsenals, is to be assimilated to a disguised poor law? Surely not; we merely propose to extend the principle, and therefore contend that if Government subsidized the unemployed labour of the country, and applied it to the formation of railroads, the payment of that labour would be in no respect of an eleemosynary character.

"But it is further objected to the plan we recommend, that it would prove an interference with the *rights* of private capital. What those rights are we have never seen formally defined, though the Manchester Chamber of Commerce has declared that "capital owes no allegiance to country"—a dogma of every equivocal patriotism. If this be true, then it follows that country owes no protection to capital, and this converse of the Manchester proposition would place capital under the ban of outlawry—a conclusion which the economists would scarcely desire to be seen drawn from their premises; for where would be the safety of their warehouses or machinery, if assailed by physical force? We will, however, pass over this difficulty, and ask 'Have the private capitalists of any country a *right* to say to the Government under which they live, *we* cannot or will not employ labour, and therefore *you* shall not employ it?' What authorises the ruled thus to dictate to the rulers? Whence is the privilege derived? What is its sanction? Does reputed liberalism claim the exercise of a pet form of class legislation?

"We are told that the law of supply and demand is the orthodox regulator of wages. Be it so. But our argument in favour of industrial armies assumes, that no employment whatever can be obtained by a certain number of labourers; and, consequently, by them no wages at all can be received. In such an extremity, the regulator has nothing to regulate, for the law is suspended. Is, then, the sinewy arm of labour to be paralyzed, when Government can infuse vigour into its inactive muscles? Certainly, exclaim the economists; for if a *minimum* of wages is established by Act of Parliament, and the working men have a sure retreat on national works, so as to avoid the Union Workhouses, a general rise of wages will take place throughout the country, and the labour-holders will be able to bid defiance to the money-holders; and this state of things would subvert the whole theory propounded in ADAM SMITH's Eighth Chapter. To labour diligently is the duty of every ablebodied man; to guarantee a plentiful reward for such labour, is the duty of Government. That is our doctrine, and the fustian jackets have to choose between us and the oracles of political economy.

"We come now to the second point of our thesis, that all men are "entitled to exchange freely." This implies the abolition of all taxes and the removal of all hinderances on industry while in the act of producing. This the private capitalists are entitled to demand of the Government, because no legislative obstructions ought to interpose between their enterprise and that labour which may render it successful. If revenue is needed, property realized is the legitimate fund from which it ought to be levied. The obligation of paying off the principal or interest of the national debt ought not to fall either on industry or the active capital by which industry is fed in the shape of wages. In a word, we are the advocates of that unequivocal and perfect free trade, which can only have a substantial existence by the abolition of Customs, Excise, and Stamps, and of every other fiscal impost which either directly or indirectly puts a toll on wages, or the fund of wages."

My next extract is on the subject of the currency—a subject not yet well understood, because public attention has not been strongly directed towards it, but like Free Trade, its depths must soon be explored and illuminated by the application of the energies of a popular agitation. The Free Trade agitation has banished the supposition of any great profundity among statesmen. They were convinced by the popular voice, and the intelligence of the people had outrun that of their rulers. The public, for the future, will examine for themselves. They will take nothing upon the faith of their superiors, by whom they find they have, for the most part, been only juggled and enslaved. The extract to which I have referred proceeds thus:—

"It appears that the mill-owners in Lancashire have begun to work short time. In some establishments, employment is only given to the operatives four days in the week. To what is this to be attributed? Surely not to over-production or the fear of it. If foreigners are amply clothed, our own countrymen are not so fortunate; and though Lancashire may not be able to find a market for its produce across the seas, where is the difficulty of securing a most ample one at home? We venture to say there are millions of men, women, and children, within these islands, who have a natural desire to consume all that is accumulated in the warehouses of the Manchester district, and to keep the steam engines in constant activity. If the two days a week of suspended labour were the consequence of all our population being abundantly supplied with manufactured articles, then indeed, our astonishment would cease, but there is no indication of such superfluity. The Highlanders in the north, the Dorsetshire labourers in the south, the Irish peasants in the west, and more than nine-tenths of the inhabitants of London, would be glad to increase their stock of cottons, and calicoes, and woollens. There is no town, however extensive, no hamlet, however obscure, in which some vacant space may not be discovered in the most modest wardrobes, ready to receive the produce of our looms. Why then do the mills work short time? Surely there is no glut within our own shores, unless we confound inability to purchase with unwillingness to consume; and if this be our predicament, why not apply a remedy? Is our machinery only to be the servant of the foreigner, to cease when he commands? Can it not minister to the necessities of our own people? It certainly does appear curious that we should be in any degree dependent on a foreign market, when we possess a most ample one at our own doors!

"The solution of this enigma is to be found in the currency, which keeps down the prices to the level of untaxed gold, and as it lowers profits, depreciates wages. This system was contrived to keep the foreign exchanges in our favour, and prevent the export of bullion. Hence the precious metals were exempted from the law of supply and demand, and tied down by act of parliament to what is termed the Mint price. Gold being the measure of value, whether coined or uncoined, and being artificially rendered permanently cheap. Goods must be cheaper even than cheap gold, for if they became dearer, the foreigner would take the gold, which is to him merchandize, not legal tender coin, and leave the goods on the hands of our manufacturers.

"The tendency, and indeed the effect of this system, is to bring all our prices down to the continental level, regardless of the difference of taxation between ourselves and foreigners; and therefore as our wages fall, they being one of the necessary elements in the cost of cheap production, our operatives must gradually sink down to the continental level of food and clothing. They have no pecuniary wherewith to purchase the produce of our looms, for however cheap cottons and woollens may become, wages must be still cheaper: and this sufficiently explains why our working classes are half clad. They are willing to consume, but unable to purchase. How then shall we stimulate both the home and foreign trade, so that machinery may not be dormant? The problem involves these conditions, low prices abroad, high prices among ourselves. Is this practicable? We think it is; indeed we regard it as the most facile of operations, if people will only clear the dust from their eyes.

"Money, rightly understood, is merely the distributive instrument of the products of industry, and as these increase, money ought to increase, or the distribution cannot be effected. Money, rightly understood, has no intrinsic value, nor is it the measure of value; it is a mere conventional token, the servant of man, not his master. Every nation, therefore, for itself and its own peculiar uses may fabricate its own money out of whatever material it pleases, and nothing more is needed than that Government should constitute that instrument a legal tender in discharge of debt. When gold of full weight, is made the legal tender, we are in the rude state of barter, for a bit of bullion is a commodity of merchandise, and the impress of the Queen's head adds nothing to its value; that impress is no more than a guarantee to those who receive it that it is of full weight and of a determinate fineness.

"Money is the form in which the subject pays tribute or tax to the Government under which he lives. It is therefore of no consequence to the foreigner whether this money be scarce or plentiful, or whether it is made of iron, or leather, or paper. He pays tribute or tax to his own Government, but none to the Government with whose subjects he is a mere trader. With them he exchanges his goods according to the universal measure of value, or gold; he calculates how much gold he shall get in weight and fineness, or the equivalent in commodities, and it matters not a straw to him whether the *monied* prices are high or low, for he merely buys and sells in *gold* prices. He never troubles his head about the *currency* of any other country than his own. If the value of a bale of cotton be equivalent to 4*l.* or 6*l.* in our *money*, it is quite immaterial to him; for whatever it may be, he gets his amount of precious metals, or their worth, as estimated in the markets of the world.

"It is evident, then, that the home and foreign trade should be carried on upon widely different principles. We require high prices among ourselves, because we are highly taxed, and because our scale of living is high. We therefore require a currency of such a nature as will allow prices to rise to the level of our taxation, and to the standard of our living. Our powers of production are inexhaustible; we therefore need an instrument of distribution in harmony with those powers, or they must be suspended, and suspended labour is national loss, and national suffering. Now national notes, to the extent of our annual taxes, would admit of this rise. In them we should discharge all our transactions among ourselves; and reserve the whole of our gold for foreign purposes. Thus we should keep our machinery constantly at work; high money wages, and constant employment to supply domestic demand, to which there is no limit but the money to purchase with, would keep the home trade in constant and progressive activity; the foreign trade would be unaffected by these internal regulations; we should sell as cheaply as ever to foreigners in gold prices, and the exchanges would remain undisturbed."

All this appears to me very clear and conclusive, and is in consonance with your doctrine, that gold should not be taken as the only representative of value, when there are vast quantities of wealth which it cannot represent, and of which no use in ordinary commercial transactions can consequently be made. I should not, however, be content with national notes to the extent of our taxation, but I think with you that Government should establish national pawnbroking establishments where national notes would be advanced on property of every description, as I believe is done in France.

I am, &c., S. Y.

*Engineers in the Navy.*—The following letter has been sent to *The Times*

Sir,—I have, with some surprise, read a paragraph in *The Times* of the 20th inst., in which it is stated to be the intention of the Admiralty to make the engineers of Her Majesty's navy, commissioned officers, and that they are to mess with the lieutenants, &c.; also that Messrs. Baker and Brown, of the Victoria and Albert and the Bee, have already joined the wardroom mess of Her Majesty's ship Excellent.

Now, without in the slightest degree wishing to say anything against that class of officers (engineers), I believe I am speaking the sentiments of every officer in the navy when I say that such a step as that proposed in *The Times* would not only give great dissatisfaction, but would be prejudicial at the same time to the service in general; and I believe firmly that the engineers themselves will be against anything of the sort. They would feel themselves placed in a position they were not intended to fill—among a

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superior class of people altogether, and by whom, generally speaking, they would be looked down upon as out of their station in society. As far as Messrs. Baker and Brown are concerned, they are most respectable, and I dare say well educated men; the former I know well, having been in the Victoria and Albert with him, and every officer will speak in equally high terms of him as I do. Yet I much doubt whether Mr. Baker would not prefer remaining where he is. Those two are, however, exceptions to the general rule, and for one that would be found equally respectable, there are a hundred who would be the contrary. It is urged in *The Times* that by placing engineers on a footing with commissioned officers they would be able to hold direct communication without applying through another officer. He is at liberty to do so now as much as any officer, but at the same time if any thing is wrong in the engine-room, it is his duty to report the same direct to the officer of the watch (be he mate, midshipman, or lieutenant), who has charge of the ship for the time, and is answerable for everything that occurs in her. There are forms to be observed in the service which placing engineers on a footing with their superiors will not do away with. Why are they, more than gunners, boatswains, &c., to take a leap from the engine room to the ward-room? If it is so necessary that they should be always in communication with the captain, it would be better they should mess with him; then they would have it all to themselves. Why should not also the second and third engineers be advanced to the midshipmen's mess; and perhaps the stokers, &c., would also like to be advanced? But, as I said before, I do not wish to say a word in disparagement of the engineers; they are a most useful class of men, but they are not "gentlemen;" they may be well educated, but their education is merely in their own line. They have a mess place to themselves, with lots of room for drawing, working, and everything else. The fault of the whole thing I believe to be this:—Hitherto the captains and officers of Her Majesty's steamers (at least a great number) have been entirely at the mercy of the engineer, and if he reports the engine out of order, the captain believes it, because he is not able to ascertain whether such is the case or not, not knowing much about the engine. Mind, I do not say all the captains, because I know well that we have some who understand equally well, if not better than the engineer, everything connected with the engine,—Austen, Ramsay, Lushington, for example; but others know no more about steam than steam does about them. While such a state of affairs exists, it is not to be wondered at that the Admiralty have so petted the engineers, given them better pay than any class of officers under the rank of commander gets, or is ever likely to get, first-class engineers getting 16*l.* a month, while lieutenants at the most only get 15*l.* 8*s.* after an indefinite period of service, and are now contemplating putting them into the wardroom to mess with commanders, lieutenants, &c. The Whigs may do many foolish things, but I do not think they would do quite so silly a trick as this. Let all officers appointed to steamers (executives only, of course,) be fully competent in the knowledge and management of the machinery, and everything connected with it; there will then be no necessity for this entire dependence on the engineers, and it will, I trust, do away with the necessity also of placing men in their situation of life on a par with their superiors. With many apologies for thus trespassing on your time, and hoping you will give this a place in your columns.

I have &c., WARDROOM.

To this weak and presumptuous letter several replies have appeared in *The Times*, and we have also the following:—Sir, I see in *The Times* of the 24th. a characteristic letter from an officer of the Wardroom, objecting to the promotion naval engineers to the rank of commissioned officers, on the ground that they are not "gentlemen," and are persons of defective education. Are then our ships to be manned exclusively with pedants and posture masters? Are there no qualifications under Heaven of the slightest avail except book learning and facility of grimace? Your correspondent does not deny that naval engineers occupy an anxious and arduous position, or that they discharge their duties with alacrity and success; he does not deny that many of them are men of energy and strong sense, or that out of the class he would "put down" the ranks of genius are largely recruited: but he would shut out a Brindley, from the ineffable refinements of the wardroom, because he happens to be deficient in penmanship, and exclude a Rennie, Smeaton or Watt, because as working mechanics, they must be unfit for the company of that "superior class of people" by whom the wardroom is exclusively tenanted, and "by whom they would be looked down upon as out of their station in society." Is then the quality of skill or efficiency in a difficult office of such little moment in the eyes of these "superior people" as to constitute no claim to consideration? and are the only criteria of eligibility for the public service to be high birth and the easy assumption of the graces of a coxcomb? No 'gentleman' in the just acceptation of that term would "look down" upon a fellow officer, on account of the accidents of birth or education being less in his favour, and the Admiralty will certainly stand justified in the eyes of the country by looking to the real efficiency of the service in its promotions, though it may offend the fastidious tastes of a cabal of dandies.

It is not the fact as your correspondent insinuates, that engineers are content with the position they have heretofore occupied in the navy, the fact being, that for years past they have been agitating the present question, and many representations have been made to the Admiralty on the subject. Nor does it involve any great demand upon the imagination to answer your correspondent's enquiry "why engineers more than gunners, boatswains, &c., should take a leap from the engine-room to the ward-room." The officers of the wardroom are supposed to occupy their places there on account of the importance of the functions they perform, and in a steam vessel. the functions of the engineer are at least as important as those of any other officer. Why then should he be made the sole exception to the law, by which rank in the service is governed? The gunner or boatswain of a steam vessel does not require to be a person of much skill or capacity, and his tasks are such only as many men in the crew could equally well perform; his position does not involve any such responsibility as that which attaches to the engineer who has a numerous engine-room crew to govern, and is accountable moreover for the safe custody and skilful use of a most expensive and delicate machine. The man who is eligible for the discharge of such duties can hardly be so deficient in intelligence or weight of character as to be unfit for the ward-room mess; and there is no need for the retention of ineligible engineers in the service if the desired ameliorations be conceded. Your correspondent, however, presents the Admiralty with an alternative remedy. He proposes that the commanders of steam vessels should be required to learn something of steam science, whereby they might virtually become the chief engineers of their own vessels. But if commanders assume such an office, they must be prepared to take all the responsibility attaching to it; and wherein could the service be a gainer when the said commander is utterly incompetent to discharge them? Steam engines are things of too costly a nature to be wantonly subjected to so rash an experiment, the more especially as amateur engineering has generally been productive of disaster. A smattering of engineering is attended with all the dangers of a little knowledge; and although the nautical man, by undergoing the same training as the engineer, would no doubt arrive at the same measure of capacity yet even then he could not reconcile the performance of his engineering with his nautical duties without compromising the efficiency of both. If he gave the requisite attention to the engineer department, he could not interfere in any other. Instead of being a lieutenant or commander, he would then be an engineer, and, as such, he would claim the very concessions that are at present demanded.

I am, sir, your obedient servant, A STEAMBOAT ENGINEER.

*The Greek Fire in Modern Warfare.*—I do not know the composition of the Greek Fre, or anything further respecting it, than it was a liquid fire discharged from engines like the engines for quenching fires. But why is this fire not used in modern naval warfare? It would burn a whole fleet in an amazingly short time, if judiciously applied, and no fleet would, in such ease, be available for modern warfare, unless built of iron. The engines of screw steamers by being disconnected temporarily from the screw, could easily be made to discharge an immense volume of liquid fire upon an enemy's ships. A spout of turpentine with a small nozzle meeting it for the ejection into the issuing turpentine of enough nitric or sulphuric acid to suffice for its thorough inflammation would, I think, be an eligible liquid fire. I am, &c., NAUTICUS.

*Belligerent uses of Ropes of Explosive Cotton.*—It occurs to me that in war the rigging of a ship might be set on fire by casting over it a rope of explosive cotton, by means of Captain Manby's apparatus, and then setting the rope on fire. The rope would require to be covered with an Indian rubber, or some other species of water-proof varnish; and it would give greater security in the operation of the plan if each separate strand of the rope were varnished. A rope of explosive cotton is a gunpowder train which may be carried even under water, and such ropes will probably find many important uses both for war and peece. I am yours obediently, T. TAYLOR.

NEWCASTLE. *Hydraulic Crane.*—We have had in operation here for some time a crane which is worked by water pressure instead of manual labour. It was made by Mr. Watson, an engineer of this place, under the instructions of Mr. W. G. Armstrong, a gentleman well-known for his researches in hydro-electricity. This crane differs in appearance from a common crane only in the absence of the ordinary wheelwork, the chain passing up through the central pillar, and thence along the jib to the outer extremity. At such a distance from the crane, as to allow of its swinging freely, a square chest is fixed to the ground on the top of which are three separate index plates with handles and pointers. By turning one of these handles, the weight is either raised or lowered, as may be desired, by turning the other, the crane is made to swing round in either direction; while the third is for regulating the amount of power to be applied to the crane. The novelty of this crane, and the ease and precision of its operation attract much observation, especially from strangers, and the expense of working must be much less than by the old method, one man being able with ease to attend to the machine. Mr. Watson was kind enough to show me the model of the apparatus, and I have no doubt would be willing to give you the particulars of its construction and operation. J. C.

## Art. X.—THINGS OF THE DAY.

### FINE ARTS.

*New Pictures in the National Gallery.*—The National Gallery has been re-opened to the public with sixteen new pictures—making the entire number in the collection now 212. Two of the new pictures (the Boar Hunt of Velasquez, and the Temptation of St. Anthony, by Aunibal Carracci) are recent purchases; and the remaining fourteen are the bequest of Richard Simmons, Esq. The following is a catalogue of the latter, giving the subjects and the artists' names:—Godfrey Schalken—Sassoferrato—The Madonna. Joseph Vernet—A Seaport. Hondikoeter—Domestic Poultry. Gerard Van Harp—Couventual Charity. Backhuysen—A Brisk Gale. Dietricy—Itinerant Musicians. Greuze—Head of a Girl. Nicholas Maes—The Idle Servant. Breenberg—Landscape with Figures. Both—A Landscape, Fignres by Polemberg. Canaletti—The Piazza of St. Mark, Venice. John Van Hugtenberg—A Battle-piece. Theodore de Keyser—A Merchant and his Clerk.

*Antiquarian Relics.*—The Emperor of Austria has issued an order for the preservation and publication of antiquarian relics throughout his dominions, in the interest of Science and Art. Hitherto, archæological research has been cousidered, in Austria, as coming under the denomiuatlon of treasure seeking; and one-third of all the articles found weut to the government. This privilege the emperor has relinquished, in furtherauce of the objects contemplated by his order in question.

*Researches in Nineveh.*—It appears, by an announcement made at a recent meeting of the Institute of British Architects, that Government has at length come in aid of the researches making by Mr. Layard on the site of the ancient Nineveh. A portiou of tho remarkable sculptures recovered by this indefatigable resurrectionist, it was also stated, is on their way to this country.

*Iffland, the Prussian Poet.*—At Berlin, the tomb of the celebrated dramatic poet and actor Ifflaud has been recently restored by the members of the Royal Theatre. The inscription, become illegible by time, has beeu replaced by a tablet of marble let into the masonry, and containing the actor's name, with the dates of his birth and death. These repairs have been extended to the tomb of Madame Bethmann, an actress of great celebrity in her day. who lies now by Iffland's side; and a marble slab between the two tombs is to be inscribed with the record of the restoration.

*Westminster Abbey.*—At a meeting of the Institute of British Architects it was suggested that the addition of a spire on the *crux* would make Westmiuster Abbey more uniform in its architecture with the new Parliament-houses. The Dean, however, objected.

*The Nelson Column.*—It is stated that the long procrastinated completiou of the works on the Nelson Column in Trafalgar-square will very soon be finally brought to a close. Workmen have been actively employed on the work during the last few days.

*Pinakothek at Munich.* On the morniug of the 12th of October, his majesty King Louis of Bavaria laid the first stoue of the new Pinakothek. In this building no picture can be received painted earlier than the nineteenth century.

*Destruction of the Abbey of Dissentis.*—The Swiss journal mentiou that this ancient and noble Abbey in the Canton of Grisons, has been consumed. by fire. Its magnificent church, its treasure, and its rich and splendid library, were completely destroyed. The friar, who discharged the functions of cook, perished in the flames. The Abbey of Dissentis, founded in the seventh century by Sigebert, a Scotch Benedictine, had been before burnt in 1790.

*The Fountain of Maria Theresa at Vienna.*—This work of art has lately been uncovered. It is the work of Schwanthaler; and exhibits, on a block of stone surrounded by oaks, a colossal bronze figure of Austria in the form of a virgin, her head bound with a mural crown, and having a lance and buckler in her hand. Beside her, are arranged the four principal rivers of the empire, the Danube, Po, Vistula, and Elbe.

*M. Bidault, the Painter.*—The Paris papers announce the death, at Montmorency, at au advanced age, of M. Bidault, the landscape-painter and member of the French Institute. Also, that of M. Muller, the well-known historical engraver.

*Numismatics.*—From Weimar, it is stated that the Grand Duke has opened to the public his Cabinet of Oriental Coins aud Medals, the richest of its kind in Germany. It contains, amongst others, a complete series of the coins struck under forty different dynasties of Asia.

*Fine Arts Commission.*—We learn that the Essays of Mr. Eastlake, forming the most interesting portion of the Reports of the Royal Commission of the Fine Arts, are about to be published in a separate compact form, so as to be readily accessible by those who desire to consult their valuable contents.

*Manufacturing Association of Austria.*—At Vienna, an exhibition has been opened for the display of designs for stuffs, and medals of gold, silver, and platina, are offered as premiums.

*The Scott Monument.*—Up to the preseut time, this structure has cost 15,650*l*. There are 56 niches yet to be filled with statues of the priucipal characters in Sir Walter's works.

### SUMMARY.

A full-leugth colossal statue of the late Marquess of Downshire, which was sometime ago ordered by the tenantry of the Edenderry estate, has been completed.—Waterloo place and the Parade-ground have been suggested as sites for the erratic Wellington statue, when it is removed from its present eminence.—The inauguration of the statue of King Charles John of Sweden, took place at Stockholm, on the 20th ult. The King and Royal Family were present at the ceremony. In the evening there was a concert and ball, and the city was illuminated.—The manufacturers of Elberfield, in Prussia, are at this time in a state of complete stagnation. In one manufactory alone 200 looms are standing still. More than 3000 workmen are to be seen in the streets of Elberfield in the utmost distress.—A monument will shortly be erected in Shrewsbury Church to the memory of the officers and men of the 53rd (Shropshire) Foot, who fell in India.—Buildings have been discovered iu Texas, apparently of the same antiquity as the ruinous cities in Yucatau and Guatemala.—The Marquis of Westminster is erecting a magnificent edifice at Fonthill, on the site of the Abbey.—The Scottish Association for the promotion of the Fine Arts, has issued a notice offeriug a premium of 100*l*. for the best series of six designs illustrative of the national history.—The execution of the marble bust of the late Sir Fowell Buxton, intended to be sent out to Sierra Leone, is intrusted to Mr. Bell.—In Paris, the Association of Artist Painters, Sculptors, Engravers, Architeets, and Designers is about to open an Exhibition of Pictures in the ancient hotel of Cardinal Fesch, in the Rue de la Chaussee d'Antin.—The cathedral at Glasgow was lately visited by Lord Morpeth, as Chief Commissioner of the Woods and Forests, who inspected the improvements now in progress there, and also cousidered the further improvements proposed by the architect, Mr. Blore.—It is said that Mr. Pugin has beon looking at Crockford's, and it is surmised that it is to be converted into a Roman Catholic chapel.——The large east window in the chapel of Eton College is rapidly filling with stained glass. The Marchioness of Lothian, whose son, Lord Schomberg Kerr. fell dangerously ill at Eton a short time since, has, iu grateful commemoratian of his recovery, signified to the Provost aud Fellows her intention of causiug to be filled up with the figure of an Apostle, one of the yet unoccupied compartments: and the boys are on the eve of ordering three more compartments to be supplied with stained glass. When these works are executed, there will be only eight compartments left unoccupied.——The *Literary Gazette* in reference to the Wellington statue says, with the artistic question whether a horse should be placed transversely or right "for and aft," on a position of this kind, it is not worth while to meddle. If all the ancients throughout the world had set the precedent (which, as we instanced weeks ago, they had not) it could have established no rule, unalterable as the laws of the Medes and Persians, either one way or another. The arts could never bear to be bound by such trammels, or Greece could uot have departed from the models of Egypt, nor Egypt from those of savage times. Is the thing good or bad? "that is the question;" aud we defy any intelligeut persou, with eves in his head, to assert that it is the latter. *The Illustrated News* says, when all the world was protesting against the placing the Wellington Statue on Mr. Burtou's Arch, and determining, by anticipation, that it would be a monster of disproportion, it was set up. As soou as the public breathe more freely, as if relieved from an apprehension, begin to find that the thing is not so very bad after all, and even to look at it with a sort of approval, lo! the Statue, it is said, will be taken down again! Another momentous question then arises—where shall it be placed at last? Is it always to be in a state of transit and trial; to be set up as horses are lent on liking? We have an Experimental Squadron; and, perhaps, considering our defects in matters of taste, an Experimental Statue may serve to disseminate sound principles of Art. Considering, however, that the public has gone through the three stages of feeling by which men become recouciled to worse things—that it has, "first endured, then pitied, then embraced"—it might be left where it is. by a compromise.——Public curiosity is considerably awakened as to the kind of structure Mr. Blore means to give us in his new design for the emendatiou of Buckingham Palace, and as the public has to pay the money for this extension, we think it only deceut that it should be satisfied with the plan. Thore is very little temptation to trust either to Mr. Blore's judgmeut in the matter, or that of the persons under whose authority he acts; for nearly all the recent public structures which have been subjected to this regimen are miserable failures. The present structure, which Nash aud George the Fourth concocted between them is a contemptible affair, and we do not know that Mr. Blore has given any such proofs of commanding genius as will discourage the fear that the litteness of the original structure will be communicated to proposed addition. Of course he will aspire after keeping, which is only aspiring after pettiness, and the result will probably be only to draw out this piece of architectural gingerbread to a larger superficies, without redeeming a single fault or adding a single feature of grandeur. Of course these anticidations *may* be unfounded, but the history of Londou public works is sufficicut to create them, even if there was nothing to apprehend from Mr. Blores mediocrity, and the only way to prove them to be illusory is to shew the plan, which if satisfactory, will be acknowledged to be such.

CONSTRUCTION.

*Subsidence of Earth near Birmingham*—A sudden subsidence of earth, to a depth of many feet, and in an area of about 50 feet in diameter, lately occurred in the vicinity of Birmingham, where an old coal-pit, closed for the last 13 or 14 years, had undermined the ground. The cause of the subsidence is supposed to be the removal of a stratum of water from beneath, on the opening of a new pit adjoining. A number of tenements on the brink of the gulf had a narrow escape.

*New Markets at Hull.*—The Hull town-council have again taken up the subject of new markets. The corporation-surveyor, Mr. David Thorpe, has been instructed, by vote of the council, to prepare plans and estimates, which will be ready in a month.

*The Manchester Parks.*—The Committee having effected its objects in a speedy and business-like manner, has been finally dissolved, leaving on hand a balance of 114*l.* 6s. 1d., as "a nest egg for future contributions towards the formation of another park."

*Aberdeen Improvements.*—A very efficient improvement Bill, to be applied for, is said to be in course of preparation at Aberdeen. Amongst the leading points to be kept in view, a local paper enumerates perfect drainage, regular cleansing of all squares, streets, lanes, closes and courts, an ample supply of water, stringent regulations as to scavenger work, powers for even enforcing some degree of internal cleanliness in dwellings, thorough ventilation, by new thoroughfares, proper width of streets and plans and alterations of houses, mercantile facilities, exterior adornment, &c., and it is intended to place the gas, provision markets, sewers and their produce, abbatoir and cattle market, along with water, under the management of a public board.

*New Courts of Bankruptcy.*—Application has been made to the city, on the part of the Lord Chancellor, for the purchase of the ground lately occupied by the Fleet Prison, for the purpose of erecting upon it the proposed new Courts of Bankruptcy.

*Proposed Improvements at Dorchester.*—It is proposed to erect court houses at Dorchester on premises near the jail, at an estimated expense of 12,000*l.*, reduced to 9,000*l.* by value of materials and sale of interest in present property, estimated at 3,000*l.*

*New Custom House at Southampton.*—A site adjoining the docks has been selected by the commissioners, To this, the inhabitants of Holy Rood Ward have objected, as detrimental to all property at the lower end of the town.

*Burntisland Pier.*—The Duke of Buccleuch and Sir J. Gladstone have sold to the railway company for 90,000*l.* their pier at Burntisland, together with all their rights in the Burntisland and Granton ferry. By this they will clear a profit of 35,900*l.* This sale is conditional on the proprietors of the pier and the railway company obtaining an Act sanctioning the sale of the pier and ferry to the railway.

*Level Furnaces at Brierley Hill, South Staffordshire.*—A sum of no less than 100,000*l.* has been expended, it is said, by Lord Ward on the rebuilding and enlarging of these furnaces. A railway, with locomotive engines, has been formed for the conveyance of coal and iron stone from the pits at Park Colliery to the furnaces, a length of two miles.

*New Water Company at Dumfermline.*—A new water-company has been formed with a capital of 10,000*l.*, for the supply of the town with abundance of pure water, the quantity at present provided being scarcely one-tenth of the quantity reported by the Parliamentary Commissioners on the Sanatory Condition of Large Towns.

*Illogan Church, Cornwall.*—A donation of 1,000*l.* has been given by Lady Bassett towards the re-building of this ancient edifice, which was to be re-opened at the end of November.

*Explosive Cotton.*—A trial of the explosive cotton in blasting was made lately, at Nanterre, near Paris, and with complete success, having caused explosion with greater facility and effect, and with less danger, than with gunpowder.

*Irish Labourers in France.*—A letter from Paris, states that such is the demand for Irish labourers on French lines, that they can earn from 5f. to 6f. a-day, while the native workmen only receive from 3f. to 3½f.

*Interesting Discovery.*—A Roman sewer has been discovered at Algiers, about a yard in height, and covered with thick flags. In it were found a number of coins, of Constantine the Great, and Constantine the Younger.

*Irish Fisheries.*—From the report of the Commissioners of Public Works we learn, that in the year 1845, there were 19,883 vessels and boats, and 93,073 men and boys engaged in the fisheries of Ireland.

*Tisbury Church.*—Mr. Bennet, M.P., has contributed 100*l.* to the fund in course of accumulation for its complete repair.

*Subscription for a Public Park at Oldham.*—The workmen employed at the Hartford Iron Works, Greenacres Moor, have spontaneously raised amongst themselves upwards of 60*l.* in aid of any fund that may be formed, with the object of providing a public walk or park, for the recreation of the inhabitants of Oldham.

SUMMARY.

The port of St. Ives, in the Bristol Channel, has been examined by a government surveyor, with a view of making it a harbour of refuge.——The Queen Dowager has given 20*l.* towards the erection of a new church at Douglas, Isle of Man.——It is rumoured in Liverpool that the Queen in person will open the new Law Courts there.——The shareholders have determined to proceed with the reclamation from the sea of 30,000 acres in the Norfolk Estuary.——On an average during the darker months, 890 tons of coal are every day consumed in the metropolitan gas works.——The Wesleyans are said to be erecting a school on a magnificent scale, near Taunton.——Considerable progress has now been made in the restoration of St. John's Gate, Clerkenwell; the north front is finished, and the south front commenced.——An important arrangement has just been come to by the West Riding Union (Manchester and Leeds), the Great Northern, the Leeds and Thirsk, and the Leeds and Dewsbury Railway Companies, for a joint railway station in Leeds.——The Hull General Cemetery Company are advertising for tenders for works connected with their undertaking. The drains are nearly completed, and other works are to be immediately commenced.——Formal complaint has been made against the ventilation of the Court of Common Pleas, in the hope of obtaining some improvement in it.——Since the appointment of Bishop Nixon, twelve new churches and fourteen ministers have been added to the ecclesiastical establishment in Van Diemen's Land.——On the 1st ult. the King of Denmark laid the first stone of the viaduct which will complete the railroad from Copenhagen to Rothschild.——It is said that mines of sulphuret of zinc have lately been discovered in Cumberland.——The sum of 65,000,000 fs. (2,600,000*l.*), according to a general estimate sent to the Minister of Public Works, will be necessary to rebuild the bridges swept away by the Loire and the Allier.——The Frankfort Diet has voted 100,000 florins to Drs. Schonbein and Bœttiger, provided the military commissioners report the advantages of the gun-cotton.——The parishes of St. Margaret and St. John, have agreed to devote 38,000*l.* to intended improvements in Westminster.——The Count de Castellane, after a heavy expenditure, in searching for coal in various points of the Pyrenees, has succeeded in discovering some rich beds near Bagneres.——In the diocese of Pittsburg, U.S., 15 new Roman Catholic churches are in course of erection.—According to the *Limerick Examiner*, a rich and extensive mine of lead ore has been recently discovered on the Ralahine estate, county Clare.——A vessel arrived in the East India Docks, from Adelaide and the Cape of Good Hope, respectively, brought, in addition to a very extensive cargo, the produce of both colonies, the large quantity of 600 tons weight of copper ore, the production of the Australian port first mentioned.——Three new houses have fallen without provocation in Alfred-place, in the neighbourhood of Pelham-square, Old Brompton. About a quarter of an hour previous to the occurrence upwards of twenty men were employed on the premises, but in consequence of the approaching darkness not permitting them to continue their work, they, with the exception of three, left the buildings. James Kashey, William Monney, and Patrick O'Sullivan, were left at work. They were at the top of the premises, when they were called upon by a fellow labourer, named Mullingford, in the name of God to come down, for the house was falling. The men, however, disregarded this warning, and merely replied that they were not so easily made fools of. O'Sullivan was then about to descend a ladder, but before he had reached the bottom the house fell in with a loud crash, followed by the adjoining house on the left side, and also by the partial falling of that on the right. The workman who was descending the ladder was pitched heavily forward, through which he sustained numerous very serious wounds, likely to result fatally.——The Mary-le-bone Vestry has decided on the establishment of baths and wash-houses for the labouring classes.——Notice has been given of the intended application to Parliament for a bill for constructing a bridge from Essex-street, Strand, to Dowson's Wharf, in the Marsh and Wall Liberty. Also for making a market, at the south end of the proposed bridge; to obtain powers for the compulsory purchase of lands and houses, and to levy tolls or duties in respect of the bridge and market.——The houses built at Birkenhead, for the dock labourers, are four-storied, of red brick, with light sandstone window-cills and copings. They are let out in flats or sets of chambers, consisting of two sets on each floor. Each set consists of one living room and two sleeping rooms. The floors are of arched brick. The living room is floored with a hard Welsh fire-brick tile; the sleeping-room floors are boarded. The staircases are of stone, with iron balustrades, and the whole building is fireproof. Each set of rooms is furnished with a constant supply of water, and also with sinks for washing, and a water-closet, and means of communication with a dust shaft from the whole set of chambers, by which all dust and ashes might be removed at once from the apartments without the necessity of the inmates leaving them.——The rents charged are from 3s. 6d. to 5s. each set, according to its position, but this includes a constant supply of water, and the use of one gas-burner in each set of rooms, and all rates and taxes, and moreover two iron bedsteads, and a grate with an oven, and convenient fixtures.——Letters from Cairo state that great damage has been sustained by the sudden rise of the Nile to a height it seldom attains, particularly at this season.

RAILWAYS.

*Effects of the waves on the works of the Chester and Holyhead Railway.*—During some late heavy gales, an extensive breach was made by the sea in the solid wall being constructed under the Penmaen Mawr mountain, in the line of this railway. The waves completely washed over the erection during its whole course, effecting large openings. Mr. R. Stephenson and several other gentlemen inspected the damage on the following day. The works between Conway and the Menai Bridge will, when completed, embrace a greater number of formidable obstacles than can be found for a similar distance on any other line. They comprise the following, viz., proposed bridge of iron, 400 feet in length, on Mr. Stephenson's novel plan, across the river Conway; a tunnel at Landegai, 440 yards in length, and another tunnel at the Ffiddoedd of half a mile; also, one under the mountain at Bangor of 900 yards; in addition to which there is a large amount of cutting and earthwork. To these must be added, the new bridge over the Menai of 1,400 feet. The whole is progressing rapidly, the tunnels being in a forward state. Upwards of 3,000,000 cubic yards of earthwork have been removed out of 4,420,000; and, as nearly 13,000 men are employed, no doubt is entertained that the contracts will be executed within the specified time. The proposed new bridges at Conway and the Menai are being rapidly pushed forward. The two tubes, for the down and up trains, are estimated as containing 1,200 tons of wrought iron. This mass is calculated to bear 2,200 tons, four times the burden it will ever be required to support. The rails are to be laid on prepared or vulcanised India rubber, in order to avoid the injurious effects of vibration. The tubes will be elevated to the piers in compartments, to be finally rivetted together when properly fitted. These will be fitted from pontoons, at the top of high water, by means of great hydraulic power; and it is anticipated that when the first compartment is successfully placed upon the pier, the remainder of the undertaking will be comparatively easy. Mr. Clarke, who was the resident engineer of the Menai bridge, is said to have relinquished the appointment.

*German Railways and Communications with the East.*—We have several times drawn attention to the fact, that Constantinople must be connected to Germany and Ostend, by a chain of railways, an event which must change the direction of the current of our railway transit. It would appear by the following account which we have taken from the *Railway Chronicle*, that our prediction is already nearly verified. On the 1st September two new railways were opened to public traffic in Germany, the one from Francfort-sur-l'Oder to Bunslan, a distance of 22½ German miles, or about 141 miles. This line will complete the chain which joins Berlin with Breslau, the capital of Prussian Silesia, the total extent of which is 34 German miles, or 73 leagues. The other railway, which has been opened, is that of Goethen to Bernbourg; this line is only 6 miles in length at present, but will be extended from Gottingen to Gubetz (Hanover), with branches to Berlin and Anhalt. Before the next autumn there will be entirely finished the lines from Berlin to Hamburg; that of Weissenfels (Thuringen) to Weimar, and the chief branch from that of lower Silesia, which will complete the series of chains with Berlin. On October 7, a trial train passed, for the first time, from Berlin to Boitzeuburg, a distance of 148 English miles, which was performed in eight hours and a half. It is intended, however, to perform the distance in six hours and a half. The works of the Central Hungarian proceed rapidly in the neighbourhood of Presburg; and on the section from Mark to Presburg two-thirds of the earthwork are already finished. The railway from Stutgardt to Ludwigshafen and Eslingen is opened. Berlin has now all the principal railways that are necessary, except one to connect it with Dresden, which, it was hoped, would be soon completed. The long line between Trieste and Hamburgh, exceeding 600 English miles in length, is nearly finished. Vienna and Berlin are now neighbours, and Constantinople, on the Bosphorus, is brought into communication with Stettin, washed by the Baltic.

*Norfolk Line.* The proposed new iron bridge, on the Norfolk line, owing to the castings, will take a long time to complete. It has been determined to build a temporary one, which will probably be ready in a month for the trams and trucks. The iron bridge is to be 50 feet wide, on the principle of Stephenson's Menai Bridge, perfectly level, without arches, with 7 feet between it and the river.

*The London and North Western.*—This company intend applying during the next session of Parliament for an Act to make a railway from Wellingborough to Bletchley, to form a junction at the latter place with the London and North Western and the Bicester and Oxford lines. The surveys are already in a forward state. They are also about to make a commodious and handsome railway entrance to, and improvements at the Northampton station.

*Sunday Traffic.*—Whilst the Edinburgh and Glasgow are stopping Sunday traffic, the Moutpellier and Nismes are about to take fresh means to promote it. The *Chemins de Fer* states that this company are about to reduce their fares on Sundays, for the accommodation of the poorer classes, who have no other time to devote to a little recreation. The above journal strongly recommends the plan to be adopted by all companies whose lines shall reach the French capital.

SUMMARY.

A continuous chain of lines, connecting Ostend and Trieste, the forward state of which was lately announced in the Artizan, is now through Germany, Austria, and the Lombardo-Venetian States, nearly completed, and by midsummer next the whole of the lines through Belgium, Prussia and the Austrian States will be in working operation, affording a rapid and uninterrupted route from Ostend to Trieste, for the overland mails. A railway construction runs from Vienna towards Belgrade, and several offers have been made to the Porte to construct a line from Belgrade to Constantinople.——A machine has been invented for registering the velocity of railway trains during each half mile of their transit, with the length of stoppages at stations. There is nothing very new in the contrivance which was long ago applied to steam navigation by Dr. Lardner, but it never came into general use. It is stated in one of the accounts of the destruction of the viaduct of Vierzou, that, only two days before the disaster, the engineer-in-chief of the government wrote to the directors of the central railway, stating that he had just examined it, and could pronounce it to be then in so solid a condition that nothing could affect it. The cost of this viaduct to the government is stated to have been at least thirteen hundred thousand francs.——The Electric Telegraph Company, it is said, mean to establish a central telegraph station at the Company's Depot, in the Strand, by means of which, communication will be established between that one point, as the 'centrum commune' or brain proper of the country, and its various extremities, the ultimate result of which will probably be a telegraphic communication throughout England.——The Report of the India Board, granting two sections of railway in India, one in Upper India, and the other in Bengal, is stated by the *Times* to have been carried by a large majority. 4 per cent. is guaranteed on 5,000,000*l.*, to commence when 1,000,000*l.* has been paid into the India House. This is without participation in the profits. No Company has yet been named for carrying into effect the necessary works, but it is thought the East India Railway Company will be the one selected.——From official returns it appears that in July 1845, the 37 German lines, of 469½ geographic miles, conveyed 1,806,653 passengers and 2,122,343 quintals (cwts.) of merchaudise; the receipts amounting to 1,320,334 thalers. Since then the length has increased 141 geographic miles, and the increase in the receipts compared with July, previous has been 97,628 thalers. The number of engines employed on these lines is 607, of which 407 run on the lines belonging to the companies, and 200 on those of the Government. Of these 267 dave been constructed in England, 49 in America, 46 in Belgium, 16 in France and the remainder in Germany.——The *Westmeath Guardian* contains the following:—A party of about one hundred men, some of whom were armed with sticks, visited the portion of the line under sub-contract to persons of the name of Low and Walsh, where 54 labourers were at work, and ordered them to discontinue till their wages were raised to 12*s.* a week. They struck a ganger named Macdonnell, and shoved two more of the men in the bog-hole. They then proceeded along the line from Footy's-bridge to Baltrasna, and repeated their orders to the different gangs they found at work, some of whom acted on the direction, but, we are glad to say, had good sense enough to return to their work the following day. The wages paid along the Mullingar portion of the contract are 8*s.* 10*s.* and 12*s.* per week, according to ability, the first named sum being paid to the well-grown boys, and the last to able-bodied and expert men. Horse labour is paid at the rate of 4*s.* per day.——The Loudon and York have purchased the Ambergate, Nottingham and Boston, the East Lincolnshire, and the Boston, Stamford and Birmingham; thus depriving the Eastern Counties from running on the Ambergate line from Spalding to Falkingham. The Eastern Counties now propose a line from Spalding to Lincoln, with a branch to Newark.——Cato in one of his letters to the *Times*, says, that all attempts to prevent excessive speculation in railways, and the expenditure of money in their construction, beyond what is compatible with the abilities of the country, must prove fruitless so long as railways are allowed to charge their present extravagant fares. Every man who wears a beard on his face knows that high fares are identical with high dividends, provided the fares are not so high as to discourage travelling. Whatever exceeds the average profit of capital, leads as certainly to extravagant speculation as day follows night.——Something like an expense of 100,000*l.* is vaguely hinted at as being probably necessary to repair the breaches and keep out the sea from the South Devon line at the scene of the late disaster. It surely cannot be meant that the contractors are to pay for such enormous improvements. Indeed the company's engineer, Mr. Brunel, has formed an extensive plan of restoration, irrespective altogether, it would appear, of what was previously done, or ought to have been done, by the contractors, in the original construction of this part of the line; and the directors, it is said, will spare no effort or expense on what is deemed "a life and death affair to the shareholders and the public."——In the case of the Tring, Reading, and Basingstoke bankrupt railway company, the directors will have to go through nearly the same unpleasant formalities as if they were individually bankrupt, although, by 7th and 8th Vict., cap. 3, sec. 2, such bankruptcy is not to be construed to be that of the individual. ——A Liverpool correspondent of *Herapath's Journal* says, that the Croydon Railway is to be again converted into an entirely locomotive line.

MISCELLANEA.

An Association has been formed in Boston to supply groceries at wholesale prices, after the fashion some time ago recommended in the *Artizan.* It is styled "The Working Mens' Protective Union."—There are now 90 packets trading between New York and Europe; 52 of them sail to Liverpool.—A chemist at Berlin is said to have manufactured an electrical paper, which is more explosive than the gun cotton.—The *Worcestershire Chronicle* says, that as the press has a Mrs. Gamp and a Mrs. Harris, the *Post,* since the publication of the Whig letters, ought to be known as Betsy Prig.—The beet-root crop in the north of France is affected with a contagious disease almost analagous to that of the potatoe.—A creature very similar to the ourang-outang, but bigger, bolder, and more man-like, is said to exist in the mountains beyond Westernport, in Australia Felix.—The Marquis of Lansdowne has about 700 allotment tenants near Calne, he has reduced their rents one-half in consequence of the potato disease.—The *Westminster Review* contends that the penny stamp should be removed from newspapers, and placed upon a wrapper or envelope, franking those required to be sent through the post.—At a meeting of the Tring Agricultural Association, Mr. J. A Gordon warned the landed gentry to take the sting out of the entails, or they would lose both them and primogeniture.—Mushrooms have of late been imported from St. Petersburgh.—Lord Clonbrock has consigned the greater part of his valuable stud for sale, as, he says, "It is better to feed the poor than horses." His hounds are also to be sold.—Considerable enlargements are about to be made in the Polytechnic Institution.—The Crown Prince of Sweden has lately directed several of the Runic barrows or "giants' graves," in the neighbourhood of Old Upsala, to be opened at his cost. Odin's-hill was the first opened; when clear proofs were found that the hill was not formed by nature, but by human hands, although the urn, with the bones of the individual inhumed therein, and which in all probability is in the centre of the hill, had not been found.—Messrs. Evans, of Liverpool, say that rough Epsom salts, in a strong solution, are an absolute preventive to the progress of disease in potatoes, and this remedy saves them even when they have probably reached decay.—Mr. Hume met the Montrose town-council lately. He hinted that next session would probably see a further abolition of indirect taxes, and an extensive measure of education.—Formidable new batteries are in course of erection at Gibraltar. 1000 convicts are employed at them.—Accounts just received from Western Australia bring the important information of the discovery of coal in that colony, in a plain near the Murray river, 35 miles south of Freemantle, and the scarcely less important one of the finding of a new port, which supplies the want so long felt of good and secure anchorage on the western coast.—The *Edinburgh Weekly Journal* says, that in Ireland, where the laws of primogeniture and entail are in full force and operation, we see a pauper tenantry, the landlords at variance with their tenants, the middleman in danger of assassination, and thousands of the best troops in Europe constantly held in readiness to prevent outrage. The Irish peasant, without capital, uses more primitive implements of husbandry than the French settler in the Backwoods.—At a recent meeting to establish a Juvenile Refuge in Manchester, the Archbishop of Dublin said they could educate 50 children at the same cost that they could keep one soldier.—A spot about 30,000 miles in diameter is now visible between the sun's centre and his eastern limb. Several other spots of less magnitude, which recently crossed the sun's disc, have disappeared.—About 1,400*l.* has been subscribed for establishing a Literary Institution at Southampton.—A new American liner called the *Sir Robert Peel,* will shortly be launched at New York.—Indian corn, an American paper shows, was selling at Davenport, Iowa, last month, at 12 1-2 cents. per qushell (one dollar per quarter), and winter wheat at 35 cents. In Liverpool, Indian corn is worth about 14 dollars per quarter.—Col. Chalmers, R.A., attended by Captain Warner, has selected the range of marsh required for the purpose of testing the powers of the long range on the east side of the Essex coast. The Treasury has granted 1,500*l.* to defray the expenses; the trials are to take place at the latter end of November, and it is stated upon good authority, that Colonel W. Dundas, C.B., Inspector of Artillery, has been selected to carry out and decide upon the merits of these important experiments.—M. Dumas has experimentally proved, that under particular circumstances sulphuretted hydrogen is converted into sulphuric acid. Volcanic vapours containing both these compounds, after being deprived of all their free sulphuric acid, soon change the carbonate of lime of the soil into sulphate of lime. The sulphurous baths of Aix in Savoy, mostly constructed of calcareous stone, disintegrate, and become covered with crystals of gypsum. The iron of the doors and windows also is rapidly transformed into the sulphate of iron, and the linen curtains that divide the baths are readily impregnated with free sulphuric acid, whereby the linen, if it be kept in a box without washing, breaks up spontaneously, and falls into powder by the slightest rubbing.—The American whaling ships in 1834 numbered 431, in 1845, 735.—In France, the number of oxen, cows, and calves is estimated at 10,000,000; in Great Britain, at 16,500,000. In France there are 32,000,000 sheep; in Great Britain 60,000,000.—The earnings of the prisoners in the Pentonville prison last year amounted to 2,842*l.* 11*s.* 4*d.*, being an average by each prisoner of 6*l.* 9*s.* 6¼*d.*—We learn from St. Petersburgh that the long-talked-of project of forming a railway from that capital to Ballishport, on the Baltic, is about to be carried into execution by a comyany formed at St. Petersburgh. The same company has also obtained an authorisation to lay down a railroad between Cronstadt and St. Petersburgh, with a branch to Moscow.—The Eastern Counties Railway Company have resolved to carry out an extension of their electric telegraph to the Royal Exchange and Lloyd's, by which instantaneous communication will be obtained with Liverpool.——A poetical contributor to the *Liverpool Mercury* invokes our living bards to laud "that gem of modern mightiness," the rising town of Crewe.——It is calculated that 260,000*l.* are paid weekly to railway labourers in England.——An agreement has been completed between the Ashburton and Newton and the South Devon railways, the latter to take the line, paying the shareholders 4 per cent. with half profits.

THE END OF VOL. II.


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